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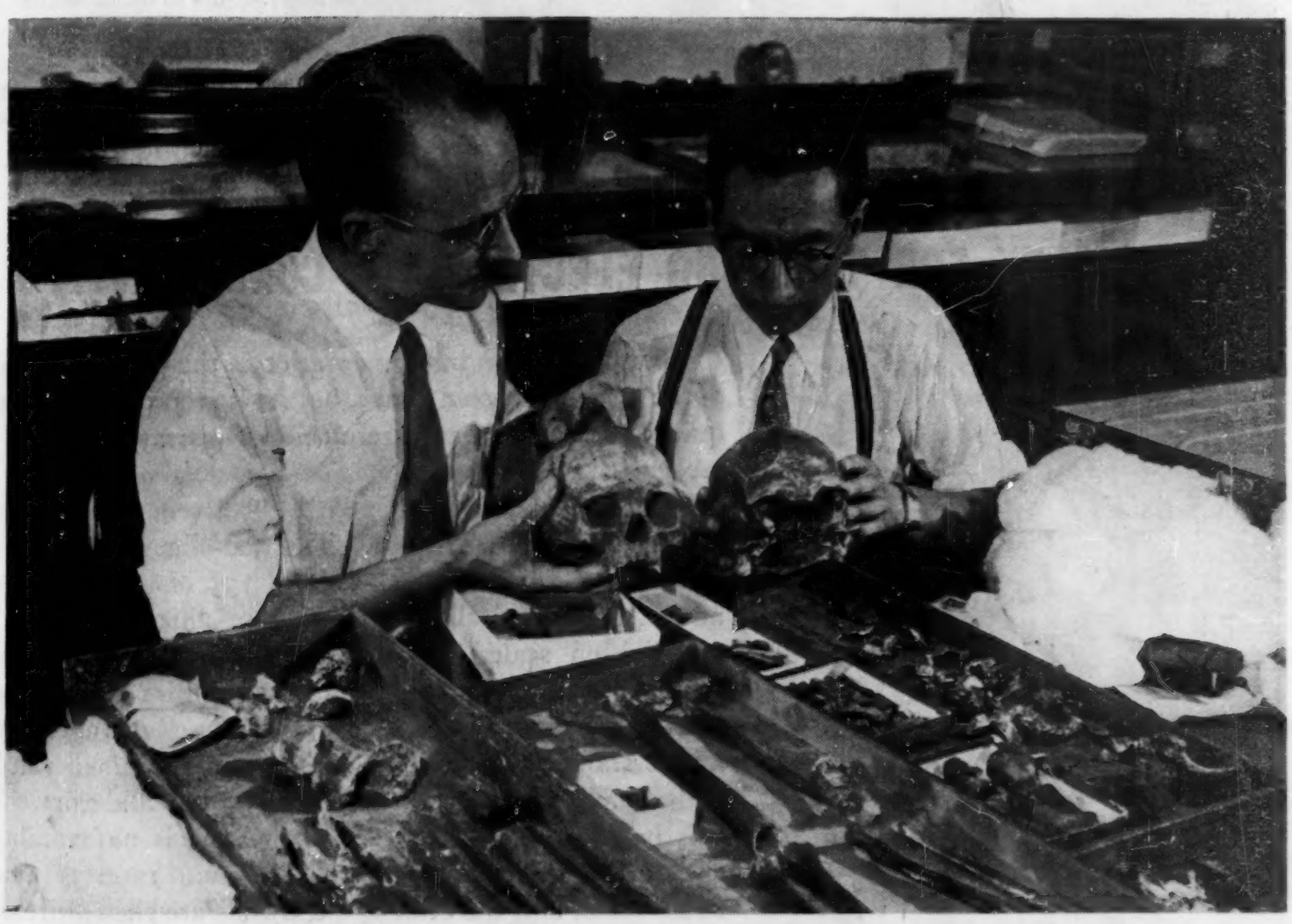

T. Dale Stewart (*left*), curator of Physical Anthropology, U. S. National Museum, and Javier Romero, who holds a similar post at the Museo Nacional de Antropologia, Mexico City, shown in Washington, D. C., shortly after unpacking the fossilized bones of Tepexpan Man (*Science*, May 9), brought to this country by Sr. Romero on June 27. Dr. Stewart holds the skull of a modern American Indian; Sr. Romero, that of Tepexpan Man.

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Science and the Public

R. W. Gerard

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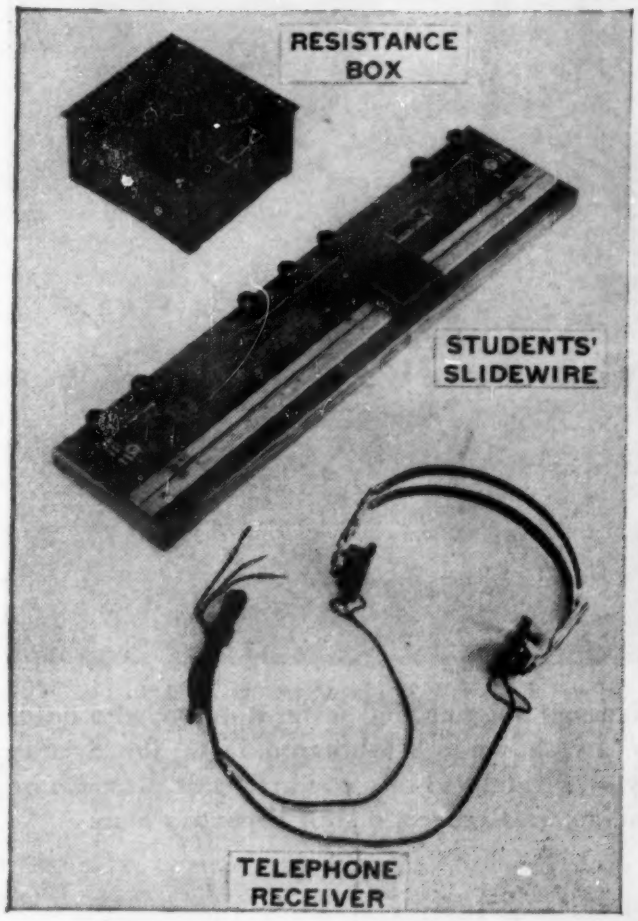

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Science and the Public

R. W. Gerard

Department of Physiology, The University of Chicago

THE EXISTING RELATIONS BETWEEN science and the public can still be summed up largely in the anecdote used by Lord Rayleigh at a similar occasion a decade ago. The great Australian transcontinental railway had been completed, and the first train was being dispatched at a gala ceremony. At the climactic moment, the passengers waved, the crowed cheered, the signal was given, and the locomotive proudly started off—leaving the train standing. Someone had forgotten to couple the engine to the cars.

True, in the interval the public has become far more aware of science and scientists of the public, thanks largely to the drama—or should I say tragedy?—of the atom bomb. But this awareness, on the public side, is in some ways even worse than indifference, for the people think of science more and more as a sort of black magic, threatening their traditions continually and likely to blow them up momentarily. Even at best, science to them is the creator of comfort-improving gadgets or of miracle drugs, never an objective attitude and a rational attack on problems. Yet it is the attitude and method of science which can save society, even more surely than some products of science can destroy it.

It is also true that in the past decade many scientists have accepted and struggled to perform their obligations to the greater community of which scientists are part. The American Association of Scientific Workers, the American Federation of Scientists, and particularly the Federation of Atomic Scientists—all groups concerned broadly with such ends—and increasingly the AAAS, have achieved some real results, and individual scientists have given unreservedly of their effort and influence. But, by and large, the scientists and technologists remain somnolently unaware of the world beyond their equations, spectrometers, microscopes, or oscillographs. A year ago, the grouped chemical societies of Chicago, in cooperation with the AAAS, arranged a first-rate symposium on the relations of government to science. A few handfuls of chemists came to listen. In November 1946, the Chicago Technical Societies Council, representing scientific engineering and technological societies with a membership of 21,000, staged a comparable panel on UNESCO and science, and only 200 of the tickets were taken by its members. Dr. Compton's story of his sister in India is still apposite. Annoyed with the endless requests of the native electrician for instructions, she burst out, "Why don't you use your common sense?" "Madam," he replied with grave courtesy, "Common sense is a rare gift of God. I have only a technical education."

The means to improvement are different in the two cases. Scientists need a broader educational base before ascending their towers of specialization, a base including not only some acquaintance with the wider problems of society but even a more vivid indoctrination with their own scientific method. This, however, leads into problems of higher education for the few, whereas this symposium is directed primarily to the problems of basic education for the many, and so to the other pole of the relationship.

The engine of science is running, but if it does not pull the public passengers with it, it will not long be stoked. The coupling must be closed by means of the media of mass communication. The technological devices for this are now abundantly available; their use and abuse will be the subject of the following speakers. I can be most useful, perhaps, in specifying further the present and the desirable relation between science and public.

First, what is the public entitled to, and what is it not entitled to, in the way of science news? It is not entitled to sensational, uncritical, and often partisan reports on results or conclusions which have not yet run the normal gamut of scientific testing. The validity of research findings should not be argued before the public as jury. The mass audience of magazine or newspaper, movie or radio, does not have, and cannot possibly have, the knowledge which entitles it to make a judgment—nor do the writers or producers, except in rare cases where they have themselves had extensive experience as active scientists. Only the collective and slowly accruing labors of the actual workers in a field can render a useful decision. (I do not say a true decision, for obvious reasons. "Useful" means that it leads to further theoretical understanding or to successful practical application.) This decision may be essentially unanimous, as when penicillin burst forth as a successful antibiotic, or may for a period involve two or several opposed positions, as in the running battle over the nature of cosmic rays. Of course, as evidence mounts, such disagreements resolve and a unanimous position is reached.

From the opening lecture presented at a round-table discussion on "Science and the Public," AAAS meeting, Boston, December 28, 1946.

Author's note: Names of specific writers, magazines, and newspapers, as well as a discussion of details of the Kenny publicity, have been deleted by the editors for publication.

Presumably the public is entitled to know of penicillin as soon as laboratory and clinical trials have convinced those working with it, as a group, that it has the virtues anticipated. Early publication may still cause great anguish to investigators flooded by appeals for unavailable material and to relatives believing their loved one is dying in the presence of succor, but it may also arouse great action and accelerate use and speed advance. Publicity is essential in health campaigns against tuberculosis, cancer, and the like. The public is also entitled to know, if interested, of the ray-particle debate about cosmic energy reaching our planet. This, at the lowest level, gives something to gape about; at a higher level—that is, with the arguments and evidence for each view presented—it can be highly educational and stimulating. At neither level, however, can the public do anything about it or become personally involved.

The case is quite different when the public *is* involved not merely as spectator or student but as actor or judge. When a popular monthly magazine published a glowing account of a foolproof treatment of ringworm, by a mixture of 50 per cent camphor and 50 per cent carbolic acid, it created an epidemic of severe skin burns and performed a disservice to everyone except possibly some financially low dermatologists. On what evidence were such claims publicized? Had the magazine or the author the scientific or moral right to decide that the claims of a particular experimenter were sound?

More recently, a well-known science writer on a metropolitan daily newspaper burst forth with starry-eyed accounts of Bogomolets' antiage, anticancer, antireticular serum. His stories were the first word I had of the ACS work, and, I must confess, though reasonably familiar with the area of knowledge involved, I was quite unable to tell from them what had actually been done or even what was the reasoning behind the work. This was unfortunate, since this particular writer had quoted categorically a sentence from my book, *Unresting cells*, published several years earlier, in which I summed up some biological evidence that the human life span might be as long as 150 years; and this mention flooded me with hundreds of letters begging for information or, mostly, for treatment.

Shortly thereafter I had an opportunity to talk at length with the associate director of Bogomolets' Institute and with the secretary general of the Soviet Academy of Medicine, both of whom assured me that there had been no significant trials of ACS on longevity or cancer, in man or animals, and that the public furor stirred up in this country (far more than in Russia) had done real damage. There was only some evidence that ACS accelerates the healing of bone fractures and chronic ulcers.

As a final example on this point I merely mention the publicity accorded Sister Kenny and her treatment for infantile paralysis. The most effective treatment of poliomyelitis will be determined by no popular vote or movie producer but by continued scientific investigation and clinical experience. Science, medicine, and the public alike suffer when any other approach is attempted. On the other hand, when answers have become clear, such motion pictures as those presenting the lives of the Curies, Ehrlich, and Pasteur offer invaluable vehicles for education of the public.

If we think of science as an exciting sport, as indeed it is, then the final score of each game is certainly for the public. So also is the inning-by-inning progress, provided it is clearly recognized by all as just a progress report and provided the reporter has some official or semi-official authority for his statements. Still better, if the public is taught some of the rules of the game, it can follow with excitement a play-by-play account. It must never be placed in the role of umpire. Also, it must learn to respect the expertness of the players. This last is a most critical point.

The egalitarian philosophy of America proclaims that all men are created equal, and, as the Irishman said, "One man is as good as another, or maybe a little bit better." In discarding the tradition of an aristocracy by birth we have thrown out the very notion of quality. Now, plainly, some men *are* far better than others, for given functions, by hereditary endowment or acquired experience, and the public recognizes this well enough where it is familiar with the situation. It knows that a special combination of endowment and training is needed to make a Joe Louis, a Babe Ruth, or even a Paderewski, and it would rightly scoff at a professor of sociology who pontificated about pugilism. But the reverse is not true. The public does not know sufficient about scientific evidence and procedure to recognize as ludicrous the anthropological antics of Bilbo, the biological blather of Irene Castle ex-McLaughlin, or the chemical confusion of most literary atom bombardiers. The public does not know its scientific A.B.C.'s—and it doesn't know that it doesn't know! Even at the height of scientist prestige, in a technological war, America alone drafted its science students. We cannot expect the layman to surmount his ignorance in technical matters, but we can expect him to recognize it. We must teach him the weight and value of a scientist's opinion where scientific evidence is involved. A democracy that does not respect expertness in the intellectual area, as it does in the sports arena, is bound for extinction in an age of technology!

Scientists, I have argued elsewhere, are the sense organs of the social organism which worry it forward along the path of evolution. They probe the environment and must help guide the response of the society. It is their responsibility to obtain valid information about the world and to help in its assimilation and application. The educators, whether of children or of the mass of adults, like the nervous system, must communicate such information, ***in its proper relations***, to the whole of the

body politic. The public must nourish and protect and value its scientists and educators as the body biologic does its eyes and brain. Science must be supported financially and learning prized socially far more than they are if our society is to remain healthy.

Perhaps some of the serious dislocations originate just in the fact that education and research are, for the most part, dependent on public sources for their scant support, while communication is well nourished by the profits of business enterprise. What the enlightened editor of the Sunday magazine section of a great newspaper chain told me recently is illustrative. He said that the Sunday supplement was reforming, in that features would be truly educational rather than rankly sensational. He had convinced the publisher that this approach would actually increase circulation. "But if circulation falls?" I asked. "Well, of course, we must sell papers to make a profit."

Let me sum up. For a healthy democracy the following circular relations should hold: The public should be kept informed of the authoritative advances of science and, even more, should be instructed in the manner in which science achieves them. The public must be made aware of the dignity of expertness and the compulsion of facts. Only so can the state, and all states, act rationally in this era of great sociological interdependence and tremendous physical power. Only so will science receive the financial support and dignified position it must have for the good of the whole. The scientist must recognize his role as "mover and shaker of the world," must qualify himself to shoulder his consequent responsibilities, and must in reality shoulder them. Only so will science flourish and serve. Those who work with the mass media of communication must insist on ever better standards of reliability and significance in what they communicate—standards which guarantee the discharge of a public duty as well as accumulation of a private gain. Only so will they be allowed long to continue as private enterprises. Only so can the public learn what it must know to function as a democracy.

These objectives might be achieved in many ways: by certification of newsmen; by featuring science rather than treating it as spot news; by training in scientific journalism; by liberal education of scientists; by greater public service from scientific societies, such as sponsorship of syndicated science columns or publication of science magazines (the new one, *The Sciences*, should concern the AAAS); by approval or, more dangerous, condemnation by official scientific bodies, such as the AAAS, of public reports on scientific matters; by boards of scientific consultants for newspapers, radio, etc.; by government support of research and subsidy of mass media; by government agencies of communication, such as the OIC of our State Department; and by, potentially best of all, the operation of UNESCO.

There is much to say on the changing situation up to now—on the greatly improved performance and standards of science writers, fostered by their national association, who are now often as much frustrated as were the scientists earlier by the way in which the editorial desks handle their copy; on the growing interest of the public in science and of scientists in the public; on the shift of need from the mere reporting of science to the *good* reporting of science. But these are matters for careful discussion. What may be re-emphasized now is that science, communication media, and the public are inextricably bound to each other. They must not merely interact, but they must interact usefully. They are part of a whole society. For purely selfish reasons, each must minister to the needs of the others, for only so can it survive.

Use of Civilian Skills in the Army Air Forces

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THE UTILIZATION OF CIVILIAN SKILLS in the armed forces, whereby a man works at a military job similar to his civilian job, has been recognized by military personnel administrators as sound policy as a general rule, although subject to some exceptions. On the other hand, some civilian critics have been so impressed by the number of exceptions as to doubt that military procedure followed the policy.

No related published study dealing with American personnel can be cited, but there is a related English study, embodied in *Second report and a memorandum by the War Office*, published by the Committee on Skilled Men in the Services (February 1942). In that study one group of 348 men from civilian engineering and allied occupations was followed up in the military service. Of this group, 44 per cent were not serving in related military jobs, nor did they have responsible assignments. The study included Navy, Air Force, and Army personnel.

Recently it has been possible to complete a study of the utilization of civilian background by the U. S. Army Air Forces.[1] Rosters, prepared by each organization of the Army Air Forces Air Service Command located in the United States, showed, among other things, the Main Civilian Occupation and the Military Occupational Specialty for each enlisted man. The function of the Air Service Command, as its name implies, was to give service and not to fight. This service included maintenance and repair of airplanes, building landing fields, maintenance of supply records, looking after motor pools, and running hospitals. Since fighting was not a part of the activity of the Air Service Command, gunners or other purely fighting men were not numbered among its personnel. Such a restriction to nonfighting men has an advantage for the present study in that it eliminates the question of whether the use of a man in a purely military capacity is an acceptable use of civilian skill.

Nine occupations which are performed in the AAF and which are similar to civilian occupations of the same name were chosen for study: (1) cook-baker, (2) truck driver, (3) sheet metal worker, (4) machinist, (5) welder, (6) auto mechanic, (7) clerk-typist, (8) tabulating machine operator, and (9) carpenter. The choice of these occupations was also based on the fact that they were frequently performed in the AAF and that the AAF obtained considerable numbers of men with parallel civilian occupations.

A tabulation was made of the records of 100 white men whose Main Civilian Occupation was that of cook-baker, 100 white men whose Main Civilian Occupation was truck driver, and so on for each of the occupations mentioned. No records were included of men who had had more than three years of military service, since it was thought that only men brought in under Selective Service were comparable (The rosters were compiled in the fall of 1943.) In general, records were not included of men who had less than six months military service since it was considered that a man's military classification might be more accurate after such a minimum time. (Several exceptions were made to this six-month rule in order to complete 100 cases for a few of the occupations.)

For each man whose record was selected for tabulation, his Military Occupational Specialty was tabulated together with his Army General Classification Test score.[2]

Similar tabulations were made of the records for 100 white men whose Military Occupational Specialty was cook-baker, 100 white men whose Military Occupational Specialty was truck driver, and so on for each of the occupations. Again, the maximum military service was three years and the minimum in most instances was six months, for the reasons stated above.

A civilian auto mechanic might not be assigned in the AAF as an auto mechanic but might be making considerable use of his civilian skill by being assigned, for example, as a Diesel mechanic. Or the civilian auto mechanic might be making some use of his civilian skill in an assignment such as airplane armorer. As a matter of fact, Army Regulations provide such classifications in terms of (1) military assignments most highly recommended for a particular civilian occupation, and (2) military assignments having some relations to a civilian occupation.[3] Consequently, the Military Occupational Specialties of the 100 former civilian auto mechanics were classified as to whether they were (1) closely related, (2) moderately related, or (3) unrelated. Army Regulations were used in this classification, but since the regulations were not complete (they were not intended to be), they were supplemented on the basis of

[1] A grant from the Graduate Research Board, University of Illinois, made it possible to tabulate the data presented herein.

[2] Information about average and range of AGCT scores for military occupations is given in an article by the writer (*Educ. psychol. Measurement*, 1946, 6, 341–349).

[3] Army Regulations No. 615–26, 1942. There are later pertinent regulations, but those cited are most convenient for the present data, since the rosters were based on classifications of Military Occupational Specialties defined at that time.

judgment. This judgment was made by following a policy of classifying an occupation as closely related if there was a possibility of its being so and classifying an occupation as moderately related if there was any possibility of its being at all related. The 9 civilian occupations were similarly classified as to the closeness of relation.

The results of the 1,800 tabulations are shown in Table 1. Tabulating machine operator is the Civilian Occupation which was directly used most often in the AAF.

TABLE 1

RELATION BETWEEN CIVILIAN OCCUPATION AND MILITARY SPECIALTY

Civilian Occupation	Relation of Military Specialty		
	Close	Moderate	None
Tabulating machine operator	90	8	2
Clerk-typist	82	6	12
Machinist	40	34	26
Auto mechanic	29	45	26
Welder	43	24	33
Sheet metal worker	64	2	34
Cook-baker	52	7	41
Truck driver	15	13	72
Carpenter	14	14	72
Military Specialty	**Relation of Civilian Occupation**		
	Close	Moderate	None
Tabulating machine operator	79	14	7
Clerk-typist	44	18	38
Machinist	42	13	45
Auto mechanic	26	30	44
Welder	39	13	48
Sheet metal worker	27	21	52
Cook-baker	17	12	71
Truck driver	29	8	63
Carpenter	43	3	54

Of 100 men who in civilian life had been tabulating machine operators, only 2 were classified in entirely unrelated AAF Military Specialties, whereas 90 were in closely related specialties, leaving 8 in specialties moderately related to their civilian occupation. Clerk-typist has the next highest percentage of cases correctly classified from the standpoint of utilization of civilian skill. It may be of some importance that these two occupations standing highest in use of civilian skills are in the clerical-administrative group rather than in the maintenance group as are the majority of other Civilian Occupations studied. The fact that tabulating machine operators and clerk-typists were best classified cannot be ascribed to their skill level, since the time necessary for teaching those skills is no longer than that for machinists and sheet metal workers.

With samples of only 100 for each occupation, all differences are by no means thought to be significant. Ample military data is probably available for additional study of this problem if additional cases are desired.

The question of supply and demand is a natural one for a suggested explanation of the unevenness of skill utilization among Civilian Occupations. In other words, perhaps machinists and sheet metal workers were less often classified in the same jobs than were tabulating machine operators and clerk-typists because the supply of available specialists relative to demand was greater with respect to the two former occupations. Complete AAF data are not available, but the lower half of Table 1 suggests that supply and demand do not furnish the complete answer. If the fact that only 40 out of 100 civilian machinists were classified into closely related Military Specialties were due to supply and demand, it might be that the AAF possessed so many machinists that a large percentage had to be assigned on other jobs. The data, in so far as they go, clearly negate such an hypothesis, since it is found that only 42 out of 100 AAF machinists came from closely related civilian occupations. A similar comparison for the other occupations shows no basis for supply and demand as a major explanation of misclassification.

One question of method that may appear to be important to the results may be seized upon by anyone familiar with the details of the Army classification system. This is whether it would not have been more meaningful to use the actual AAF assignment rather than classification. There are reasons for preferring actual assignment and reasons for preferring classification in such a study. Actually, for the sample studied there was an agreement between classification and assignment which, on the basis of casual inspection, seemed to approximate 95 per cent. An advantage of using classification rather than assignment is that a man might have been doing a temporary job or, because of equipment shortage, might not have been performing the job for which he was classified.

One point frequently raised with respect to a direct comparison between civilian and military jobs is that a person with a supervisory job might be doing something of greater value to the service, even though his supervisory job was not closely related to his civilian job. This point is fairly well covered in the present study, since supervisory jobs that utilize a person's civilian skills in any way have been classified as either closely related or moderately related, depending on the nature of the case. For example, a civilian auto mechanic classified as a motor transportation NCO was tabulated as a case of "close" relation, and a civilian auto mechanic classified as a supply NCO, as a case of "moderate" relation. It is true that there are examples of noncommissioned officers whose classification bore no relationship to their civilian skills. Such cases, of course, would be found under the column headed "None," but they were extremely rare.

The top half of Table 1 shows that the median for the column headed "None" is 33. In other words, for these 9 occupations the AAF utilized the civilian skill of approximately two men in three—by a classification either

closely related or moderately related to his civilian job. In the other one case out of three there was no relation between Civilian Occupation and Military Specialty.

The range of nonuse of civilian backgrounds is striking. As shown in Table 1, it varies from 2 to 72 per cent.

Practically everyone who has worked with Army classification must be familiar with the fact that the rigidity of school quotas was one big cause of failure to use civilian skills thoroughly. One Reception Center or Replacement Training Center would be forced to fill within a short time its quota of men to be sent for training as military specialists. The housing facilities of the centers were not sufficiently great to hold men for a considerable period of time waiting for quotas more related to their civilian backgrounds. Undoubtedly such school quotas constituted an explanation of many of the failures to use civilian backgrounds that are reflected in Table 1. As a matter of fact, the rosters that were used show which school was attended in the Army. A preliminary tabulation of such data has been made.

Civilian tabulating machine operators were employed by the AAF in the highest percentage of cases among the occupations studied. Next in percentage of utilization are civilian clerk-typists. The former worked under administrative officers who were closely connected with those supervising the AAF Classification and Assignment Program. For clerk-typists, though they were assigned in almost every AAF organization, the situation was frequently similar. Statistics such as those in Table 1 cannot prove why one civilian skill would be neglected in only 2 per cent of the cases while another skill would be neglected in 72 per cent of the cases. These data do indicate that where, for some reason, sufficient pressure exist, civilian skills can be utilized almost perfectly.

The Cooperative Committee on the Teaching of Science and Mathematics:

Its Organization and Program

THE COOPERATIVE COMMITTEE ON Science Teaching was created in 1941 by representatives of several scientific societies to work on educational problems the solution of which can be attained better by cooperative action than by any single scientific group working alone.[1] Subsequently the Committee published a "Preliminary Report on the Preparation of High School Science Teachers," which has been used by a number of university and college faculty committees. Another problem attacked by the Committee—that of using high school science and mathematics to meet manpower needs during the war—resulted in a report on "High School Science and Mathematics in Relation to the Manpower Problem," which was published in 1943 and distributed to more than 12,000 individuals.

A further function of the Cooperative Committee has been to serve as a forum in which representatives of the scientific societies have been able to state the views of their own groups and to learn those of other groups on science teaching at the secondary and elementary levels.

The Committee has an advisory relation to its parent organizations and reports to them regularly through their representatives.

The Committee, as organized in 1941, consisted of the following representatives of scientific societies:

American Association of Physics Teachers: K. Lark-Horovitz, Purdue University, and Glen W. Warner, Wilson Junior College, Chicago.

Union of Biological Societies: Oscar Riddle, Department of Genetics, Carnegie Institution, and Walter F. Loehwing, State University of Iowa.

Mathematical Association of America: A. A. Bennett, Brown University, and Raleigh Schorling, University of Michigan.

American Chemical Society: B. S. Hopkins, University of Illinois, and Martin V. McGill, Lorain High School, Lorain, Ohio.

National Association for Research in Science Teaching: G. P. Cahoon, Ohio State University, and Robert J. Havighurst, University of Chicago.

The initial financial needs of this Committee were met by grants totaling $3,000 from the Carnegie Foundation for the Advancement of Teaching.

The original Committee served for three years without change of personnel and was then reorganized as a committee of the AAAS.

Invitations to associations to be represented on the Committee originate from the Executive Committee of the AAAS, each organization then submitting its choice to the Committee for confirmation and final appointment. In making selections, particular attention has been given to adequate representation of the teaching profession of secondary schools, colleges, and universities. The Committee selects its own chairman and secretary.

[1] The Committee is indebted to President Emeritus E. C. Elliott, of Purdue University, who supported its early activities in every way.

As presently consituted, the Committee's chairman is K. Lark-Horovitz, Purdue University, and the secretary, R. W. Lefler, Purdue University. The following societies are represented:

American Association of Physics Teachers: K. Lark-Horovitz, Purdue University, and Glen W. Warner, Chicago City College.

American Astronomical Society: Oliver J. Lee, Northwestern University.

American Chemical Society: B. S. Hopkins, University of Illinois (recently resigned and to be replaced).

American Institute of Physics: Lloyd W. Taylor, Oberlin College.

American Society of Zoologists: L. V. Domm, University of Chicago.

Botanical Society of America: Glenn W. Blaydes, Ohio State University.

Central Association of Science and Mathematics Teachers: Arthur C. Baker, Cleveland Board of Education.

Division of Chemical Education, American Chemical Society: Laurence L. Quill, Michigan State College.

Executive Committee, AAAS: E. C. Stakman, University of Minnesota.

Geological Society of America: George A. Thiel, University of Minnesota.

Mathematical Association of America: Raleigh W. Schorling, University of Michigan.

National Association of Biology Teachers: Prevo L. Whitaker, Indiana University.

National Council of Teachers of Mathematics: E. H. C. Hildebrandt, Northwestern University.

National Science Teachers Association: Morris Meister, Bronx High School of Science.

The expenses of meetings, held at least twice a year, are now borne by the parent organizations, who pay the travel expenses of their respective representatives. Should the Committee engage in special projects requiring money for research or for publication, such funds are secured from interested sources. Thus, the parent organizations are not obligated beyond providing for the attendance of their own representatives at meetings.[2]

In order to preserve continuity of both interest and attendance, it is desirable that the parent organizations name their representatives for terms of several years, with different termination dates in cases of more than one member, and that they name representatives who are willing and able to attend all meetings of the Committee.

Committee Activities 1945–1947

Recently the Committee prepared and distributed a report on "The Preparation of High School Science and Mathematics Teachers," in which the following concrete proposals were made:

(1) A policy of certification in closely related subjects within the broad area of the sciences and mathematics should be established and put into practice.

(2) Approximately one-half of the prospective teacher's four-year college program should be devoted to courses in the sciences.

(3) Certificates to teach general science at the 7th-, 8th-, or 9th-grade level should be granted on the basis of not less than 42 semester hours of college courses in the subjects covered in general science.

(4) Colleges and certification authorities should work toward a five-year program for the preparation of high school teachers.

(5) Curriculum improvements in the small high school should go hand in hand with improvement in teacher preparation.

During the last year the Committee worked with the NSTA in the preparation of a report on American science education. The Scientific Apparatus Makers of America provided funds for the preparation of this report, which has now been submitted to UNESCO.

The Committee cooperated with the NSTA in a program on science education at the AAAS meeting in St. Louis, where it also sponsored a scientific exhibit. At the Boston meeting of the AAAS the Committee again participated in the NSTA program with a series of contributed papers and, in addition, arranged for a forum on "Problems of the Science Teacher."

At the present time the Committee is engaged in a study of the effectiveness of science teaching at all levels. A report of this study will be prepared for submission to the President's Scientific Research Board.

Future Plans of the Committee

(1) The problem of licensing or certification of secondary school science teachers, with its associated problem of combinations of subjects to be taught by the beginning teacher in the small high school, is generally recognized as a serious one. Most teachers begin their work in small high schools of 200 or fewer students. In such schools one person must teach three or four different subjects. Therefore, a college graduate with highly specialized training in a single science is at a disadvantage in securing a position or in his teaching if he is appointed. The Committee hopes to formulate recommendations regarding certification requirements with which all the scientific societies can agree and which suit the realities of the teaching situation.

(2) The Committee, recognizing the difficulty of preparing science teachers for such broad teaching assignments as are given to most new teachers, has been making a careful study of these problems and will release soon a proposal for a college program of study for the prospective teacher which will secure the necessary breadth of science

[2] The Committee is indebted to President F. L. Hovde and Prof. C. W. Beese, director of the Division of Technical Extension, both of Purdue University, for making available the services of R. W. Lefler as secretary.

training, give reasonable opportunity for specializing in one science, and provide for professional courses in education as well as a sufficient number of courses for general education.

(3) The Committee hopes to stimulate the science departments of a number of colleges and universities to bring secondary school teachers to their campuses for cooperative work on their educational problems. Out of workshops and conferences held at colleges and universities would probably come plans for improved science courses. These activities would provide good in-service training for science teachers and would enable the secondary school teachers to make their problems and their points of view evident to the college scientist.

(4) The Committee offers its services as a consultant to state or local agencies working on problems pertaining to science teaching. In this way, direct connection may be provided between such agencies and the societies represented on the Committee. For example, the Committee might become associated in a curriculum study in some state, cooperating with the state department of education and the college and secondary school science teachers. The results of such a project might prove valuable to other states. On the other hand, the Committee plans to call in consultants from the teaching profession to obtain expert advice on problems related to the science curriculum in secondary schools and questions of teacher training.

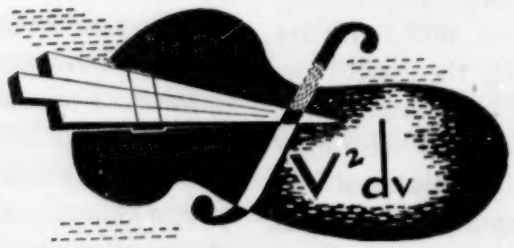
The time is ripe for important developments in science education. This Committee, by bringing together representatives of the scientific societies and by consulting with administrators, supervisors, and teachers who are concerned with the science curriculum, hopes to aid in the development of a more effective science program in this period of change.

(5) Reports will be made on the need for legislation leading to Federal *support of science teaching in the high schools*. The need for scholarships on the senior high school level is as urgent as it is on the college level. Extension of the Science Talent Search to states and recommendations for Federal support of a scholarship program are of deep concern to the Committee.

(6) The Committee will cooperate with the National Science Teachers Association and other organizations in projects for the improvement of teaching aids in science. Projects are now under way for the development of low-cost laboratory equipment, for visual aids, and for the study of teaching techniques.

(7) The Committee proposes to study possible procedures for certification of competency, with special reference to the development of instruments for appraisal of the prospective teacher.

(8) It is also planned to give serious consideration to a coordinated science curriculum in the schools, with particular emphasis on the proper grade placement of concepts and ideas.



NEWS *and Notes*

The Association regrets to announce that on July 5 Dr. Otis W. Caldwell, general secretary of the AAAS and member (ex officio) of the Executive Committee since 1935, died in New Milford, Connecticut, following a cerebral hemorrhage. At the time of his death Dr. Caldwell was also serving as chairman pro tem of the Managing Committee, AAAS-George Westinghouse Science Writing Awards. He became a Member of the AAAS in 1900, a Fellow in 1902, and a Life Member in 1923. In 1925 he was vice-president of the Section on Education. For many years he worked very actively with the officers of the affiliated Academies of Science and recently had devoted a large measure of his time to the Near East Foundation, of which he was a director.

About People

William E. Purnell, Sydney, N. S. W., has been appointed counselor in charge of Field Scientific Operations for the Natural Science Section of UNESCO. Mr. Purnell will coordinate the three Field Science Cooperation Offices which UNESCO is setting up this year in Rio de Janeiro and Cairo and in China. Plans for a fourth office, to be set up in India next year, are being formulated.

Dallas B. Phemister, Thomas D. Jones professor and chairman, Department of Surgery, University of Chicago, retired July 1 but will continue at the University as Thomas D. Jones professor emeritus. Dr. Phemister was succeeded as chairman of the Department by **Lester R. Dragstedt,** professor of surgery.

T. C. Schneirla, formerly associate professor of psychology, New York University, and associate curator, Department of Animal Behavior, The American Museum of Natural History, has been promoted to curator at the Museum.

Donald S. Fleming, assistant professor of bacteriology and immunity, has been named secretary to the Faculty of Medicine, McGill University. Dr. Fleming succeeds **John F. McIntosh,** who has returned to his former position at the Royal Victoria Hospital.

Paul Campbell Young, professor of psychology, Louisiana State University, is visiting professor of psychology at Southern Methodist University, Dallas, Texas, for 1947–48.

Ray D. Owen, on leave of absence from the University of Wisconsin as a Gosney Research Fellow at California Institute of Technology, has been appointed associate professor of biology at the latter institution.

Roger H. Bray, research soil chemist, University of Illinois, addressed the annual banquet meeting of the University of Kentucky Chapter of Sigma Xi, May 9, on "The Nature of a Fertile Soil."

Frans Verdoorn, managing editor of *Chronica Botanica*, was appointed an honorary staff member of the Government Botanic Gardens, Buitenzorg, Java, at the 130th Centenary of the Garden, May 18, in recognition of his wartime work on behalf of the scientific institutions of the Netherlands Indies.

Carsten Steffens, Solvay Process Company, Syracuse, New York, has been appointed director of chemistry and chemical engineering, Stanford Research Institute.

Sheldon Clark Reed, Harvard University, has been appointed associate professor of zoology and director, Charles Fremond Dight Institute for the Promotion of Human Genetics, University of Minnesota.

Roland Wendell Harrison, dean, Division of Biological Sciences, University of Chicago, has been elected a vice-president of the University. Dr. Harrison succeeds **Lawrence A. Kimpton,** who has resigned to become dean of students and professor of philosophy, Stanford University.

Myrtle Collier, chairman, Department of Mathematics, Immaculate Heart College, Los Angeles, California, has retired as professor emeritus.

Cleveland Norcross, formerly administrative officer and recently executive secretary of OSRD, on July 1 became assistant director of the American Institute of Physics, 57 East 55th Street, New York City.

Edward Ross has been appointed associate professor in the Department of Horticulture, Washington State College, Pullman, and associate horticulturalist in the Agricultural Experiment Station for industrial research in food technology.

Visitors to U. S.

Sydney Goldstein, professor of applied mathematics, University of Manchester, England, and chairman, Aeronautical Research Council, Ministry of Supply, will be at Brown University during August and will give a series of 20 lectures on "Dynamics of Compressible Fluids." Dr. Goldstein will also lead a seminar on the same subject.

Lennart Grone, manager, Department of Agricultural Machinery, Alnarp Agricultural, Dairy and Horticultural Institute, Akarp, Sweden, is visiting this country for six months to discuss farm machinery problems with experts in this field. Mr. Grone, who has recently been visiting the Iowa State College campus, plans to extend his trip to include many of the midwestern states.

F. T. Gerson, Plastics Department, Almex Ltd., Birmingham, England, is visiting the Frederick S. Bacon Laboratories, Watertown, Massachusetts, technical representatives of Almex in this country, to study materials and methods used in the U. S. plastics industry.

Grants and Awards

Harold L. Temple and **Sydney Weintraub,** Department of Radiology, Cornell University School of Medicine, have been granted a research fund to support further studies in the field of radio-opaque media. The grant has been established by the Schering Corporation, Bloomfield and Union, New Jersey.

Leo I. Dana, research manager of the Linde Air Products Company, New York,

has been awarded the Jacob F. Schoellkopf Medal of the American Chemical Society's Western New York Section for his work in cyrogenics, the science of very low temperatures.

Ernest H. Volwiler, executive vice-president, Abbott Laboratories, is the recipient of the 1947 honor scroll award of the American Institute of Chemists.

The Stalin Prizes, awarded annually for outstanding accomplishments in the arts and sciences, have been received by the following scientists: N. N. Bogoliubov, professor of physics, for work in statistical physics published in 1945 and 1946; Y. I. Frankel, Leningrad Physical-Technical Institute, for research on the theory of the liquid state published in the monograph, *The kinetic theory of liquids*; M. A. Pavlov, for his work, *The metallurgy of cast iron*; A. S. Arbuzov, professor at the Kazan Chemical Institute, for research on phosphorus; N. G. Khlopin, professor at the Kirov Military Academy, for his work in the field of biology; I. P. Razenkov, for discoveries in nutrition and digestion; and S. P. Obnorsky, director of the Russian Language Institute, Academy of Science, for his published work on the history of Russian literature and language of ancient times.

The Chevalier du Mérite Agricole has been conferred by the French Government upon Henry Solon Graves, dean emeritus, Yale School of Forestry; Lyle Watts, chief, U. S. Forest Service; Edward I. Kotok, assistant chief of the Service; and Tom Gill, member of the Forestry Advisory Committee of the UN Food and Agriculture Organization.

Colleges and Universities

At recent commencement exercises in U. S. colleges and universities, the following scientists received honorary degrees: John H. Van Vleck, Harvard University, the D.Sc. from the University of Wisconsin; C. B. Huggins, University of Chicago, the M.Sc., and A. F. Blakeslee, Smith College, the D.Sc. from Yale University; Roger Adams, University of Illinois, the D.Sc. from the University of Pennsylvania; Vannevar Bush, Carnegie Institution of Washington, Louis S. Gates, mining engineer, New York City, and Harvey S. Mudd, mining engineer, Beverly Hills, California, the D.Sc. from Columbia University; W. Paul Briggs, Pharmaceutical Division, Veterans Administration, and Waldemar Kaempffert, the *New York Times*, the D.Sc. from the Philadelphia College of Pharmacy; Lloyd A. Hall, Griffith Laboratories, Chicago, the D.Sc. from Tuskegee Institute; Carroll L. Wilson, Atomic Energy Commission, the D.Sc. from Williams College; Laurence H. Snyder, Ohio State University, the D.Sc. from Rutgers University; Oswald T. Avery, Rockefeller Institute for Medical Research, the D.Sc. from New York University; Edwin H. Land, Polaroid Corporation, Cambridge, the D.Sc. from Tufts College; Columbus O'Donnell Iselin, Woods Hole Oceanographic Institute, the D.Sc. from Brown University; William A. Hamor, Mellon Institute, the D.Sc. from the University of Louisville; and E. R. Weidlein, Mellon Institute, the LL.D. from Washington & Jefferson College.

Yale University has announced the inauguration of a new course to be offered in the fall on the Development of the Sciences, which, according to President Seymour, is designed to aid in "the closer integration of the sciences and the humanities in the college curriculum and to emphasize the contribution of the sciences to liberal education." This course, which will cover two terms, has been developed by a committee consisting of Joseph S. Fruton, associate professor of physiological chemistry; Henry Margenau, professor of physics; Talbot H. Waterman, assistant professor of zoology; and Edmund W. Sinnott, director of the Division of the Sciences.

Armour Research Foundation, Illinois Institute of Technology, has announced the following promotions: M. H. Heeren, to director, Research Division, and executive chairman of the staff; Carl Titus, to director, Magnetic Recording Division; K. W. Miller, to assistant director of the Foundation; Horace Quinn, to assistant director of research; M. E. Nelson, to assistant director of international operations; and E. H. Schulz, to chairman, Electrical Engineering Research.

Baylor University College of Medicine, Houston, Texas, has announced the following faculty appointments: Russell J. Blattner, Washington University School of Medicine, as professor and chairman, Department of Pediatrics; Warren T. Brown, Yale University School of Medicine, as professor of psychiatry and chairman, Department of Neuro-Psychiatry; Russell C. Huggins, University of Georgia School of Medicine, as associate professor of pharmacology; A. S. Harris, Western Reserve University School of Medicine, as associate professor of physiology; F. B. Moreland, Kansas State Board of Health, as associate professor of biochemistry; and Dan E. Jenkins, University of Michigan School of Medicine, as assistant professor of medicine.

The University of Wisconsin has announced the retirement in June of the following faculty members: Florence E. Allen, assistant professor of mathematics; Leon J. Cole, professor of genetics; William O. Richtmann, professor of pharmacognosy; and John R. Roebuck, professor of physics.

Brown University has announced the promotion of George F. Carrier to associate professor of engineering, Graduate Division of Applied Mathematics, and S. Wing Handford to associate professor of biology. Leaves of absence for the second semester of the academic year 1947–48 have been granted to George L. Church, professor of botany, and Carl W. Miller, professor of physics.

The School of Medicine, Louisiana State University, has announced the following appointments: James D. Rives, formerly clinical professor of surgery, as professor and head, Department of Surgery, succeeding Urban Maes, who has retired as professor emeritus; Robert L. Simmons, formerly director of the Lauderdale, Mississippi, Health Unit, as associate professor of public health and preventive medicine, succeeding George W. McCoy, who has retired as professor emeritus; Sidney S. Chipman, formerly practitioner of pediatrics, Norwalk, Connecticut, as associate professor of pediatrics; Nelson K. Ordway, Yale University, as assistant professor of pediatrics; and Edwin S. Kagy, Tulane University School of Medicine, as clinical assistant professor of medicine. Joseph A. Danna and Narcisse F. Thiberge have been appointed clinical professors emeritus of surgery and medicine, respectively.

The University of Puerto Rico, Río Piedras, P. R., has announced that it can no longer sponsor the Santiago Primate Colony, consisting of approximately 400 rhesus monkeys (*Macaca mulatta*) of different ages, located at Cayo-Santiago, about a mile from the eastern coast of Puerto Rico. Equipment consists of an adequate living house, two storehouses, land and water transportation facilities, and water system. No cases of tuberculo-

sis have occurred there in the last six years. Institutions interested in acquiring the Colony, in whole or in part, or in assuming its sponsorship are requested to communicate with Dr. Facundo Bueso, Dean, College of Natural Sciences.

The University of Nebraska has announced that the following have been promoted to full professors: Marcus D. Weldon, Department of Agronomy; Carl E. Georgi, Department of Bacteriology; Donald A. Keys, Department of Operative Dentistry; and A. A. Luebs, Department of Mechanical Engineering.

The University of Pittsburgh has announced the following as visiting lecturers in psychology during the summer session: Lewis R. Wolberg, Victor C. Raimy, Virginia Axline, Samuel B. Hadden, Gregory Zilboorg, and William A. Hunt. The lecturers will cooperate in offering a six-week course on Approaches to Counseling, Guidance, and Psychotherapy for clinical psychologists, psychiatrists, and social workers.

Industrial Laboratories

Leeds & Northrup Company has announced that E. Burk Estabrook, of its sales department, is visiting Sweden at the invitation of the Royal Swedish Academy of Engineering Sciences and the Association of Swedish Technical Physicists. On June 5 Mr. Estabrook addressed Swedish engineering societies at Stockholm on "Automatic Temperature Control in Industrial Processes."

Carl S. Miner, founder and director of the Miner Laboratories, Chicago, has been elected to the Board of Directors, Universal Oil Products Company, Chicago.

General Electric Company is carrying out a $300,000,000 expansion program, designed to meet the increased demand for peacetime products. At Electronics Park, a $25,000,000 project to be located near Syracuse, New York, and now nearing completion, the Company will concentrate on electronics engineering, research, and production of devices in the field. Among other projects already in process or contemplated are a $20,000,000 factory building at Schenectady for the manufacture of steam turbines and electric generators; an $8,000,000 new Research Laboratory, to be completed early in 1948 at The Knolls, near Schenectady; operation for the Atomic Energy Commission of a $20,000,000 atomic power laboratory to be constructed in the vicinity of the new Research Laboratory; and construction of a $5,000,000 plant at Waterford, New York, for the manufacture of silicones.

Elections

The Society for American Archaeology has elected Frederick Johnson, Andover Academy, president; Earl Morris, University of Colorado, first vice-president; Isabel Kelly, University of California, second vice-president; and Waldo Wedel, U. S. National Museum, secretary.

The American Academy of Arts and Sciences recently elected the following Fellows: Howard H. Aiken, Arthur W. Allen, George P. Baker, David L. Belding, Ruth F. Benedict, Hans A. Bethe, Richard Burgin, Thomas D. Cabot, William H. Claflin, Jr., Edward U. Condon, Paul C. Cross, John R. Dos Passos, Arnold L. Gesell, Sanford B. Hooker, Mildred McA. Horton, Mark DeW. Howe, Wilbur K. Jordan, Milton E. Lord, Ralph Lowell, Charles W. MacGregor, Lewis Mumford, Norman B. Nash, John L. O'Brian, William Phillips, Francis M. Rackemann, Ivor A. Richards, Fritz J. Roethlisberger, James S. Simmons, Richard M. Smith, Merrill C. Sosman, Clark C. Stephenson, William F. Twaddell, Shields Warren, and Sumner Welles. Foreign Honorary Members elected include: Paal Berg, Hamilton A. R. Gibb, Augustus D. Imms, Joseph Klausner, P. Maheshwari, Edward A. Milne, Alf E. Porsild, Meghnad Saha, Gregory A. Shajn, Godfrey H. Thomson, George P. Thomson, Ivan M. Vinogradoff, and Wen-Hao Wong.

The Pittsburgh Geological Society elected the following officers at its annual business meeting May 16: Shailer S. Philbrick, U. S. Engineers, president; John T. Galey, Independent Oil and Gas Operator, vice-president; David K. Kirk, Gulf Research & Development Company, secretary; and Charles H. Feldmiller, Equitable Gas Company, treasurer. Councilors elected for two-year terms are: L. Guy Huntley, consulting geologist; Chilton E. Prouty, University of Pittsburgh; and F. C. Hauber, The Peoples Natural Gas Company.

The American Society for Pharmacology and Experimental Therapeutics, at its Chicago meeting, May 18–22, elected the following officers for the coming year: Maurice H. Seevers, University of Michigan Medical School, president; Carl A. Dragstedt, Northwestern University Medical School, vice-president; H. B. Haag, Medical College of Virginia, secretary; K. K. Chen, Lilly Research Laboratory, treasurer; and J. C. Krantz, Jr., University of Maryland School of Medicine, and Hamilton H. Anderson, University of California Medical School, councilors.

The American Institute of Nutrition has elected as officers for the coming year: R. M. Bethke, president; E. M. Nelson, vice-president; N. R. Ellis, treasurer; H. E. Carter, secretary; and A. D. Holmes, councilor.

The Alabama Academy of Science, at its annual meeting in Birmingham, May 1–3, elected the following officers for the coming year: John Xan, president; E. D. Emigh, president-elect; A. T. Wager, secretary; R. D. Brown, treasurer; and E. B. Carmichael, editor of the *Journal of the Alabama Academy of Science.*

Over 100 members attended the sessions, and 52 papers were presented, J. L. Kassner, the retiring president gave the annual address at the banquet on the topic, "Science in a Changing World."

The American Institute of Electrical Engineers, at its annual meeting in Montreal, June 11, elected the following officers: Blake D. Hull, Southwestern Bell Telephone Company, St. Louis, Missouri, president; G. W. Bower, Haddonfield, New Jersey, J. H. Berry, Norfolk, Virginia, I. M. Ellestad, Omaha, Nebraska, D. I. Cone, San Francisco, California, and D. G. Geiger, Toronto, Ontario, vice-presidents; W. L. Everitt, Urbana, Illinois, A. C. Monteith, East Pittsburgh, Pennsylvania, and Elgin B. Robertson, Dallas, Texas, directors; and W. I. Slichter, New York City, treasurer.

The Louisiana Academy of Sciences, at a recent meeting held on

the Louisiana State University campus, elected the following officers: George H. Mickey, Louisiana State University, president; Percy Viosca, Jr., Southern Biological Supply Company, New Orleans, vice-president; H. B. Boudreaux, Southwestern Louisiana Institute, secretary-treasurer; George Kent, Louisiana State University, acting editor; and S. J. P. Chilton, Louisiana State University, permanent secretary. Divisional chairmen elected were: Mary Warters, Centenary College, biological; Lorimer E. Story, Louisiana Polytechnic Institute, social sciences; John B. Entrikin, Centenary College, physical sciences; and Bert B. Boyd, Northwestern Louisiana College, junior academy.

The Crystallographic Society has reported election of the following officers: John W. Gruner, University of Minnesota, president; A. Pabst, University of California, who succeeds to president in 1948, vice-president; William Parrish, Philips Laboratories, Inc., Irvington-on-Hudson, New York, secretary-treasurer (1947–49); and Samuel G. Gordon, Academy of Natural Sciences of Philadelphia, and George Tunnell, Carnegie Institution of Washington, councilors.

The West Virginia Academy of Science elected the following officers at a recent meeting: J. E. Judson, West Virginia Wesleyan College, president; Nelle Ammons, West Virginia University, vice-president; A. H. VanLandingham, West Virginia University, treasurer; and N. Bayard Green, Marshall College, secretary.

The next meeting of the Academy will be held at West Virginia Institute of Technology, Montgomery, West Virginia, April 30–May 1, 1948.

The Medical Library Association, at its 46th annual meeting in Cleveland, Ohio, May 27–29, elected the following officers: Eileen R. Cunningham, Vanderbilt University Medical Library, president; Janet Doe, New York Academy of Medicine Library, vice-president and president-elect; Howard Dittrick, Dittrick Museum of Historical Medicine, Cleveland, honorary vice-president; Edna M. Poole, Academy of Medicine, Toronto, Canada, secretary; and Edith Dernehl, Marquette University School of Medicine, treasurer.

The 1948 convention, about which no final decision has yet been made, will mark the 50th anniversary of the founding of the Association.

At the 25th annual meeting of the Virginia Academy of Science at the University of Virginia, May 8–10, held jointly with the Virginia Junior Academy of Science, Arthur Bevan, state geologist, and president of the Academy, announced the winners of the second Virginia Science Talent Search, which was in charge of an Academy committee headed by Alfred L. Wingo, of the State Department of Education. Top winners were Edward Minter Foley of Danville, and Melissa A. Warfield of Norfolk. A $50 U. S. Savings Bond was presented to each of the 15 winners, and $10 to each of the other 27 who qualified for final judging. Joyce Stoutamyer of Front Royal and Richard A. Waterval of Alexandria were awarded memberships in the AAAS, and Audrey Moore of Newport News, Bernard Brown of Norfolk, and Julian A. Scott of Eastville were awarded memberships in the Academy for their outstanding work in the Junior Academy.

Academy officers elected for the coming year are: Jesse W. Beams, University of Virginia, president; E. C. L. Miller, re-elected secretary-treasurer; Rodney C. Berry, Virginia State Department of Agriculture, assistant secretary; and Allan T. Gwathmey, University of Virginia, Council member. Sidney S. Negus, Medical College of Virginia, Richmond, was named president-elect to succeed Dr. Beams in May 1948.

Recent Deaths

Howard Shreve Roberts, 56, physicist at the Geophysical Laboratory, Carnegie Institution of Washington since 1917, died January 30 following an operation.

Arnold J. Gelarie, 62, specialist in rheumatic diseases, and onetime assistant, Rockefeller Institute for Medical Research, died May 9 at Montefiore Hospital, the Bronx, New York.

William Letchworth Bryant, 76, director, Roger Williams Park Museum, Providence, Rhode Island, and honorary curator of Fossil Fishes, New York State Museum, died June 9 at his home in Providence after a brief illness.

Edward Clark Streeter, 72, medical historian and curator of the museum collections of the Yale Medical Library, died in Stonington, Connecticut, June 17.

Harry Seltz, 51, professor of chemistry, Carnegie Institute of Technology, and supervisor of the Manhattan District project at the Institute during the war, died June 19 at his home in Pittsburgh.

Wilfred Hudson Osgood, 71, curator emeritus of Zoology, Natural History Museum, Chicago, died June 20 in Billings Memorial Hospital, Chicago.

Herbert W. Emerson, 67, formerly director, Pasteur Institute, University of Michigan, died June 21 at Hamilton General Hospital, Burlington, Ontario.

Lorande L. Woodruff, 67, professor of protozoology and director, Osborn Zoological Laboratory, Yale University, died June 23, at his home in New Haven.

Aaron Louis Treadwell, 80, professor emeritus of zoology, Vassar College, died June 24 at his summer home in Redding, Connecticut.

Michael Joseph Callahan, 57, manager of the Fabrics Division, Fabrics and Finished Department, Du Pont Company, died suddenly in Wilmington, Delaware, on June 25.

Make Plans for—

Fifth International Pediatrics Congress, July 14–17, Waldorf-Astoria Hotel, New York City.

Symposium on Sound, July 21–22, Salt Lake Tabernacle, and University of Utah.

The American Mathematical Society, First Annual Symposium in Applied Mathematics, August 2–4, Brown University, Providence, Rhode Island.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

TECHNICAL PAPERS

Induction of Mutants in *Penicillium notatum* By Methyl-bis(β-chloroethyl)amine[1]

MARK A. STAHMANN and J. F. STAUFFER

Departments of Biochemistry and Botany, University of Wisconsin, Madison

The efficacy of allyl isothiocyanate and the sulfur mustard gas, bis(β-chloroethyl)sulfide, in the production of mutants in *Drosophila melanogaster* has been reported by Auerbach and Robson (*1*). Gilman and Philips (*5*) and Gilman (*4*) have discussed the nucleotoxic action of the β-chloroethyl sulfides and amines. Horowitz, Houlahan, Hungate, and Wright (*7*) have reported that bis(β-chloroethyl)sulfide is effective in producing mutants in *Neurospora crassa*, while Slizynski (*8*) has shown the production of structural changes in somatic chromosomes of *D. melanogaster* by treatment with allyl isothiocyanate. The chemical production of mutants in *Drosophila* has recently been discussed by Auerbach, Robson, and Carr (*2*), but detailed reports on the efficiency of the β-chloroethyl amines in producing mutants have so far not appeared.

In view of the success that has been obtained in the induction of mutants in *Penicillium* by ultraviolet irradiation (*3*), it seemed desirable to investigate the effects of compounds of the type mentioned above upon this fungus. We have studied the action of the nitrogen mustard, methyl-bis(β-chloroethyl)-amine, in producing morphological mutants in the stable strain NRRL-832 of *P. notatum*. The nitrogen mustards were selected, since they are much easier to handle in the laboratory than the sulfur mustards. The treatment consists of simply suspending the spores in an aqueous solution of the nitrogen mustard. By way of comparison we have determined the number of mutants produced by exposing spores to ultraviolet radiation.

Treatment with the nitrogen mustard[2] was carried out by adding 10 ml. of a suspension of spores of *P. notatum* NRRL-832 containing about 130,000 spores/ml. to 10 ml. of a freshly prepared solution of methyl-bis(β-chloroethyl)amine in aqueous bicarbonate buffered solution. The nitrogen mustard solution was prepared by adding 0.25 ml. of a solution containing 19.2 mg. (0.10 mM) of methyl-bis(β-chloroethyl)amine hydrochloride to 9.75 ml. of a sterile aqueous solution containing 270 mg. (3.20 mM) of sodium bicarbonate. As soon as the liberated base dissolved (about 30 seconds) the spore suspension was added, mixed, and allowed to stand at room temperature (24° C.) with occasional shaking. At intervals thereafter, 0.40-ml. aliquots were withdrawn and added to 100 ml. of a sterile decontamination solution containing 60 mg. (0.80 mM) of glycine and 68 mg. (0.80 mM) of sodium bicarbonate. The samples of treated spores and a sample of the untreated spores were stored at 4° C. for 24 hours or longer. The diluting of the treating mixture by the glycine-bicarbonate solution effectively stops the reaction of the nitrogen mustard with the spores and decontaminates the mixture by removing the unreacted β-chloroethyl groups through reaction with water or glycine (*6*). After storage, the spores were plated out in Petri dishes on an agar medium containing 6 per cent honey and 1 per cent peptone. These cultures were incubated at room temperature for 5 days, after which counts of the total number of colonies and of mutants were made. Any colony showing morphological characters such as rate of growth, color, degree of sporulation, or character of mycelium markedly different from those commonly associated with the stable strain NRRL-832, as evidenced by the colonies produced from untreated spores on the same medium, was classed as a mutant. Approximately 1,000 spores were plated out for each of the first two and 4,000 for the remaining samples of the nitrogen mustard treatment; approximately 1,000 spores were plated out in the case of each sample of the irradiated spores. The control consisted of 3,309 colonies from untreated spores. Of these, only three could be classed as

TABLE 1

INDUCTION OF MUTANTS IN *Penicillium notatum* BY METHYL-BIS(β-CHLOROETHYL)AMINE

Treatment (min.)	Survival (%)	Mutants (% of survivors)	Mutants (% of original spores)
By methyl-bis(β-chloroethyl)amine			
0	100.0	0.1	0.1
1	60.1	0.2	0.1
2	41.3	1.8	0.7
4	31.5	8.7	2.7
8	8.9	19.6	1.7
16	3.6	29.5	1.1
33	2.6	44.4	1.1
By ultraviolet radiation			
0	100.0	0.1	0.1
5	81.0	2.2	1.8
10	48.6	8.9	4.3
15	24.5	20.0	4.9
20	3.6	23.3	0.8
25	1.6	15.4	0.2
30	1.2	10.0	0.1

[1] Published with the approval of the director, Wisconsin Agricultural Experiment Station. This work was supported by grants from the Schenley Research Institute, Eli Lilly and Company, Lederle Laboratories, and the Graduate Research Committee.

[2] Since the nitrogen mustards are very toxic, all treatments were carried out in a well-ventilated hood. The operator was protected with rubber gloves and a face shield, and pipetting was done with a bulb pipette. All glassware was decontaminated by placing in a bath containing glycine and sodium bicarbonate solution for 24 hours. We are indebted to Dr. John Hutchens, Toxicity Laboratory, University of Chicago, for the nitrogen mustard.

morphological mutants. This very low rate of spontaneous mutation serves to emphasize the stability of the particular strain used.

The results of the treatments are summarized in Table 1. It is evident that the nitrogen mustard was relatively toxic to the spores and that this lethal action continued throughout the period of treatment. Furthermore, the data show that this nitrogen mustard was very effective in producing morphological mutants and that the percentage of mutants based on the number of survivors continued to increase throughout the duration of the treatment. The percentage of mutants based on the original number of spores plated out increased from 0.1 in the untreated control to 2.7 for the 4-minute treatment. This large increase indicates that the nitrogen mustard treatment actually produced these mutants and did not merely serve as an agent which preferentially allowed pre-existing mutants to survive. The subsequent decline in the total number of mutants also indicates this nonselective action.

The data obtained on irradiating a comparable spore suspension with a narrow band of ultraviolet radiation at 2,750 A. show that ultraviolet radiation of this wave length exerts a considerable toxic action and also induces mutations. However, in contrast to the nitrogen mustard treatment, the number of mutants based on the percentage of survivors reached a maximum and then declined. The maximum number of mutants produced was somewhat higher than that obtained by the nitrogen mustard treatment.

In so far as could be judged by visual examination of the colonies, there is no essential difference between the two treatments as to the types of mutants produced. Ultraviolet-induced mutants of NRRL-832 have been carried through repeated transfers without evidence of reversion to the original form. Representative mutants induced by nitrogen mustard were carried through a second transfer and some through successive transfers without observation of any change in morphological characters. Since the sexual stage of this organism is unknown, it is impossible to study the inheritance of these induced characters by the usual methods.

On the basis of the number of spores surviving treatment, it appears that the nitrogen mustard can be more effective than the ultraviolet radiation of the wave length employed in inducing mutants in this strain of *P. notatum*.

Studies dealing with the action of the nitrogen mustards on various races of *P. notatum* and *P. chrysogenum* are being continued in investigating the variability of these organisms in obtaining races showing biochemical differences such as changed nutritional requirements and capacity to produce penicillin.

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Separation and Immunologic Evaluation of Soluble Pertussal Antigens[1]

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Leslie and Gardner (*3*) demonstrated that *Haemophilus pertussis*, the causative agent of whooping cough, is monotypic and, under adverse cultural conditions, is progressively degraded from smooth Phase I to rough Phase IV strains, the latter phase being irreversible. The development of improved pertussal vaccines by Sauer (*9*) and Kendrick (*1*) followed these observations. Subsequent clinical data indicate that prophylactic efficacy is closely related to Phase I characters.

Until recently different pertussal vaccines could be evaluated only on the basis of clinical trial, since no satisfactory laboratory test existed. However, Kendrick (*2*) has now introduced an intracerebral challenge test in mice employing live Phase I organisms. It was shown that immunization intraperitoneally with a single dose of 100,000,000–500,000,000 Phase I organisms protects mice against 100–1,000 fatal intracerebral doses of live *H. pertussis*. If the assumption is made in this test that a correlation exists between mouse antigenicity and the prevention of whooping cough in human beings and, further, that the test might distinguish quantitatively the antigenic power of different pertussal vaccines or antigens, it should be possible to evaluate antigens, other than Phase I vaccine, for their prophylactic efficacy.

Accordingly, the present report concerns studies on the immunologic evaluation by the Kendrick test of soluble pertussal antigens (SA), supplied by Lederle Laboratories. The parent materials contain, among other things, detoxified thermolabile toxins (*7*), capsular or surface antigens (*5*), as well as detoxified somatic antigens (*5*). Improved methods for the preparation of parent SA will be published subsequently (*8*). The behavior of SA in methanol-water mixtures (*4*, *6*) under controlled conditions of pH, ionic strength, and temperature is also presented.

The protective dose (PD_{50}) of the various antigens was determined by the Kendrick test. Groups of 10 mice each were injected intraperitoneally with 0.5 ml. of varying dilutions of SA or Phase I vaccine. After a rest period of 10 days, the mice were challenged intracerebrally with 100–1,000 fatal doses of Phase I *H. pertussis*. Control groups of 10 mice were employed to verify the adequacy of the challenge dose. The Standard Reed-Muench calculations were employed to determine the PD_{50} of the various antigens.

Nitrogen was determined in duplicate by the micro-Kjeldahl method of Pregl. Hydrogen-ion determinations were made on the glass electrode. Adjustment of the pH of SA for the fractionation with methanol was made with an acetate buffer (*4*) for hydrogen-ion concentrations less than pH 4.6, with acetic acid for pH 4.1, and with HCl for those greater than pH 4.1.

One volume of SA is chilled to 1° C. and adjusted to the desired pH with ice-cold buffer or acid and immediately transferred to −5° C. bath. To this mixture the calculated amount of methanol (measured at −5° C. and then chilled to −20° C.)

[1] Aided by a grant from Lederle Laboratories Division, American Cyanamid Company. Thanks are due to Frances L. Clapp and Dorothy Novotny for their aid in conducting the antigenicity tests.

is added slowly with stirring, care being taken to maintain the temperature at −5° C. The mixture is allowed to stand at −5° C.; the precipitate is removed in a refrigerated centrifuge at −5° C. and is freed of as much of the supernatant as possible by drainage. The precipitate is dissolved to 1/10 the original SA volume with ice-cold M/15 phosphate buffer of pH 7.4 and clarified by centrifugation at 4,000 r. p. m. for 15 minutes at 0° C. The purified SA samples were maintained at −30° C. until assayed.

Table 1 summarizes the results obtained with SA fractions separated between pH 2.0 and 7.0 in 40 per cent methanol at

TABLE 1

Conditions		Mg. N*/ ml.	PD_{50} (ml.)	PD_{50}'s/ mg. N	PD_{50} yield (%)†
pH	Methanol (%)				
2.0	40	0.31	0.6	5	3
3.1	40	0.47	0.06	35	27
4.1	40	0.45	0.017	131	94
4.6	40	0.36	0.025	111	64
5.1	40	0.30	0.042	79	38
6.0	40	0.21	0.041	116	39
7.0	40	0.17	0.10	59	16
4.1	25	0.35	0.16	18	10
4.1	10	0.27	0.11	34	15
Parent antigens		4.55	0.16	1.4	—

* Ten times the concentration of parent antigens.

† $\frac{\text{Total } PD_{50} \text{ precipitated}}{\text{Total } PD_{50} \text{ in parent antigens}} \times 100$.

−5° C. These data indicate that the substances responsible for the protection of mice against *H. pertussis* are quantitatively precipitated (within the limits of accuracy of the test) at pH 4.1 in 40 per cent methanol. Hydrogen-ion concentrations greater than pH 4.1 lead to an increased solubility of protective substances; those less than pH 4.1 also result in a progressive

TABLE 2

Antigen	PD_{50} (ml.)	No. of Phase I organisms/ PD_{50} (billions)
Purified SA, alum precipitated	0.004	—
Purified SA, alum precipitated + 5,000,000,000 Phase I Vaccine*	0.0026	0.013
Purified fluid SA	0.017	—
10,000,000,000/ml. Phase I Vaccine*	0.015	0.150

* Lederle # 2074-21.

loss of antigen into the supernatant fluid. On a nitrogen basis, the PD_{50} of the fraction separated at pH 4.1 has been purified about 95-fold over parent antigens. Further fractionation of this fraction has resulted in products of over 200-fold purity (5).

In other experiments it was noted that methanol concentrations under 40 per cent resulted in the incomplete precipitation of the antigenic factors. These experiments, as well as others to be reported later, suggest that two or more soluble antigens are responsible for the full protection of mice against *H. pertussis*. The above results have been duplicated with different lots of parent SA varying in PD_{50} from 0.09 to 0.29 ml.

Table 2 summarizes the results of a comparative study of the antigenic potencies of concentrated SA fractions separated at pH 4.1 in both the fluid and alum-precipitated state and of Phase I vaccine. The alum-precipitated sample is over 3 times more antigenic than the plain bacterial vaccine. The antigenicity of a mixture of alum-precipitated SA and 5,000,000,000 Phase I organisms was 5 times as great as that of the vaccine. Concentrated fluid SA compares favorably with a 10,000,000,000 Phase I vaccine.

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Some Effects of Ultraviolet Light on 2, 4-D and Related Compounds[1]

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Studies of the action of ultraviolet light on plant growth-regulating compounds have been limited. In 1938 Gilman, in studying the effect of ultraviolet light on unsaturated compounds (*3*), reported that ultraviolet light changed trans-cinnamic acid to a mixture of cis-cinnamic, truxillic and truxinic acids. A year later, Zimmerman and Hitchcock (*5*) showed that the relatively inactive trans-cinnamic acid could be changed to the active cis-cinnamic acid by ultraviolet light. Other workers have noted the effect of light on naturally occurring growth substances. It was shown by du Buy in 1933 (*2*) that white light (not specified) plus heat decreased the growth substance supply in the *Avena* coleoptile. The work of Boysen (*1*) suggested that auxin-a is inactivated, at least in part, by white light but that heteroauxin (indole-3-acetic acid) is not.

The objective of the study reported here was to determine the effect of ultraviolet light on 2,4-D, the sodium, ammonium, and triethanolamine salts, and the methyl, ethyl, and butyl esters. Also included were studies on 2-methyl-4-chlorophenoxyacetic acid. These compounds were selected because they were the active ingredients in most of the hormone-like herbicides available during 1945–46. The results of such a study should assist in the interpretation of comparative field tests when these compounds are used as weed killers.

The chemicals used in this study came from several sources. The 2,4-D (m.p., 139°C.) was prepared in the laboratory of the Chemistry Section, Colorado Agricultural Experiment

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[2] The authors gratefully acknowledge the guidance of Andrew G. Clark, professor of mathematics, in the statistical analyses of the data, the technical assistance of Mrs. Nellie Landblom, and the laboratory assistance of Mrs. Patricia Wilson and Miss Madelene Worley.

Station. This was dispersed in Carbowax 1500. The ammonium salt of 2,4-D was obtained from the Du Pont Semesan Company. The monohydrated form of the sodium salt was obtained from the J. T. Baker Company. The 2,4-D dispersed in triethanolamine was made in this laboratory by dispersing purified 2,4-D in 10 times its weight of triethanolamine. The methyl ester used was the Dow Chemical Company product called Dow-G-652 and contained 22.75 per cent of the ester. The ethyl ester was the 1945 product (Formula No. 2) of the Sherwin Williams Company. This contained 75 per cent of the ester. The butyl ester was the Sherwin Williams Company 1946 product ("Weed-no-more 40"), which contained 40 per cent by weight of the ester. The compound 2-methyl-4-chlorophenoxyacetic acid was the 1946 Du Pont Chemical Company product called "Methoxone," which contained 85 per cent of the active ingredient.

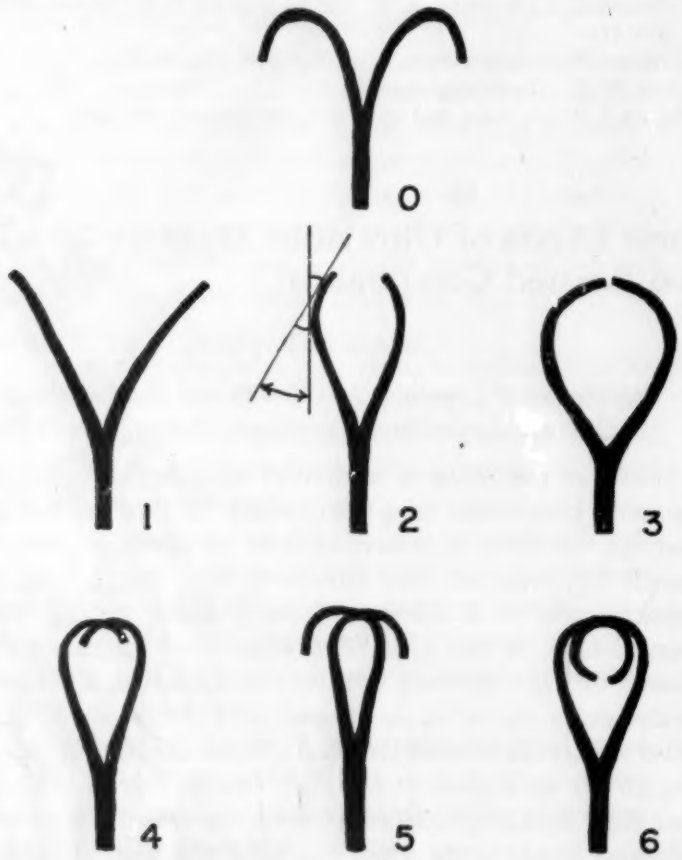

FIG. 1. Pea-stem growth-curvature classes: 0 = zero inward curvature, typical of distilled water; 1 = slight inward curvature; 2 = tips parallel to and inward curvature of 45°; 3, 4, 5, 6 = average inward curvatures between 45° and 90°, between 90° and 135°, between 135° and 180°, and greater than 180°, respectively.

Samples of all chemicals were treated by placing them in sterilized Petri dishes and irradiating for a 12-hour period. The layer of material in each case was approximately 2 mm. thick. At hourly intervals each dish was stirred, shaken, and leveled. Two sources of light were employed: a GE Mazda mercury-arc lamp, type A-H4, with a 100-watt capacity, used without a filter, and the same type lamp of 250-watt capacity, used with a black light filter. The two standard filters used were Nos. 5860 (51) and 5970 (41). Separate series of each chemical were treated with each filter. Transmission measurements of the filters were made in the Physics Department, Colorado Agricultural Experiment Station. It was found that the range of No. 5860 (51) was between 3,407 and 3,888 A., with a peak at 3,600 A.; that of No. 5970 (41), between 3,306 and 4,000 A., with a peak at 3,700 A. and a small amount of transmission in the red between 6,800 and 7,500 A. Transmission in the ultraviolet for No. 5860 (51) was 35 per cent and for No. 5970 (41) 45 per cent.

Among the numerous biological tests for measuring the growth-regulating properties of organic chemicals are those involving measurements of root-growth inhibition, epinasti

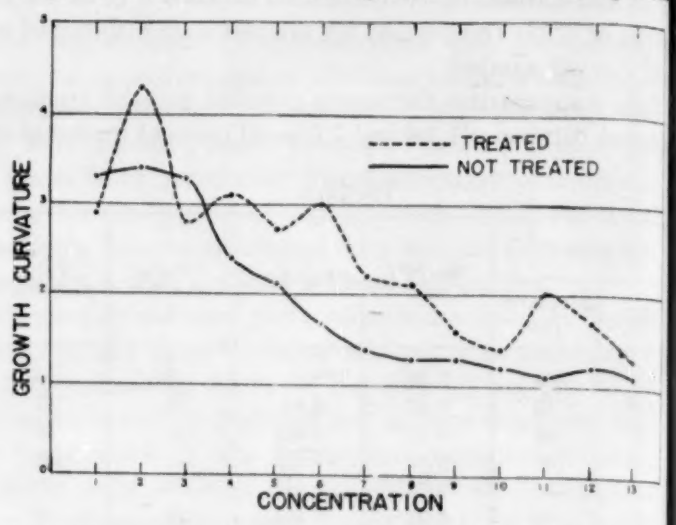

FIG. 2. Pea-stem growth-reaction curves of 2,4-D and of the same compound treated with ultraviolet light (3,407–3,888A.).

response, and growth curvatures of the oat coleoptile and of the split stem-tips of peas. Went's pea test (*4*) was selected in this study because it provided an adequate number of observations for statistical study and because of the ease of obtaining uniform plants.

For each compound, four pea tests (one for each light treatment and control) with 13 concentrations were used, and 10 pea stems were employed in each concentration. Each compound was irradiated according to the three treatments described above.

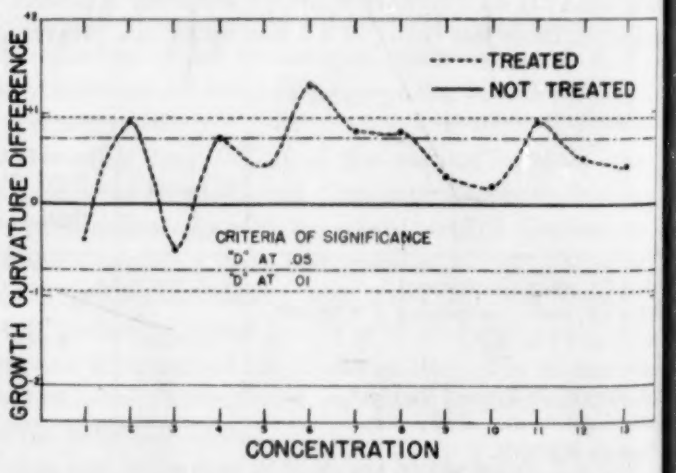

FIG. 3. Criteria of significance of the growth-curvature differences data shown in Fig. 2.

All solutions were made on a molar basis, such that the weakest concentration (No. 1) corresponded to .000029 M and the strongest (No. 13) to .122000 M. The highest concentration was made by direct weighing and making up to volume; all others, by diluting in such a manner that each succeeding dilution was one-half the concentration of the preceding one. This particular series of concentrations was selected because of the relationship to the sodium salt of 2,4-D expressed in parts per million, *i.e.* concentration No. 1 corresponds to 8 ppm and No. 13 to 31,942 ppm.

The growth curvature of each pea stem was classified according to the system indicated in Fig. 1.

In studying the growth curvature results for each compound, variance analyses were made for each treatment with its control (chemical without light treatment), in order to eliminate error due to treatments and within treatments. Then the criterion of significance of difference, or d-value, between means of each pair (treated chemical and untreated) was found. To facilitate the reading of these differences, graphs were made of those between the two means at each concentration, and the criteria, or d-lines, were drawn at the .05 and .01 levels. This procedure is illustrated by the pea reaction curves for 2,4-D and for the same compound treated with ultraviolet light (filter 51) Figs. 2 and 3. A similar procedure was used to study the effect of ultraviolet light on all other compounds investigated. Results and their significance are summarized in Table 1.

The trend of these results indicates that ultraviolet light of the range and intensity described, when transmitted by filter 51, can be used to activate 2,4-D, the sodium salt, the butyl ester, and 2-methyl-4-chlorophenoxyacetic acid. Comparative tests of the herbicidal effects of these chemicals activated with ultraviolet light and those of untreated chemicals are suggested.

It is recognized that, with the exception of 2,4-D, pure compounds were not used in this investigation. Possibly purified salts and esters might give different reactions than the impure commercial mixtures used. Had this work been done first on the purified compounds, the question of its action on commercially available herbicides would still have been unanswered, and this was the question of immediate importance.

The results further suggest a possible explanation of the variable results secured from uniform trials of 2,4-D and similar compounds at different times and places. Since the amount of ultraviolet light reaching the earth varies with change in atmospheric conditions, altitude, and season of the year, the herbicidal effects might be expected to vary accordingly. Field tests designed to settle this question are suggested.

TABLE 1

Chemical	No.	Light treatment	Concentration 1	2	3	4	5	6	7	8	9	10	11	12	13
2,4-D	31	Mercury arc	I	I	S	I	I	I	S	0	I	I	I		
		Filter 41	I	I	I	I	I	I			S	I	S	S	S
		" 51	I	S	I	S	S	S	S	S	S	S	S	S	S
Sodium salt of 2,4-D	124	Mercury arc	S	S	S	S	S	S	S	S	S	S	I	S	S
		Filter 41	I	I	I	S	S	S	I	I	I	I	S	I	I
		" 51	S	S			S	S	S	S	S		S	I	I
Butyl ester of 2,4-D	150	Mercury arc	F value not significant												
		Filter 41	"	"	"	"									
		" 51	S	S	S	S	S	I	I	S		I			
Ethyl ester of 2,4-D	151	Mercury arc	F value not significant												
		Filter 41	"	"	"	"									
		" 51	"	"	"	"									
Methyl ester of 2,4-D	184	Mercury arc	"	"	"	"									
		Filter 41	"	"	"	"									
		" 51	"	"	"	"									
2,4-D dispersed in triethanolamine	152	Mercury arc	I		I	I	I	I	I	I	I	I	I	I	I
		Filter 41	F value not significant												
		" 51	S	S	I	I	S	S	I	S	S	S	S	S	S
2-methyl-4-chlorophenoxyacetic acid	204	Mercury arc		I	I	I		I	I	S	S	S	S	S	S
		Filter 41	F value not significant												
		" 51	S	S		I	0	I	S	S	S	S	S	S	
Ammonium salt of 2,4-D	149	Mercury arc	I	I	I	I	I	I	I	I	I	I	I		
		Filter 41	I	I	I	S	S	I	I	S	I	I	I	I	I
		" 51	I	I	I	I	I	I	I	S	I	I	I	I	I

The letter I indicates inferiority of the irradiated chemical; the letter S, superiority. A single asterisk indicates significance at the .05 level; a double asterisk, at the .01 level.

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Utilization of Vitamin A in Water Emulsion

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The utilization of vitamin A is to a large degree dependent upon the quality of its carrier oil, in which it is dissolved (*3*). The utilization of vitamin A in vegetable oil and in water emulsion was studied during an investigation of the effect of peroxides on vitamin A absorption in chicks.

The vitamin A was derived from two different gray fish-liver oils of similar potency. Oil # 1 was freshly prepared, while oil # 2 had undergone considerable oxidation during long storage. The characteristics of the oils (*2*) are collected in Table 1.

TABLE 1

Physicochemical Characteristics of the Two Gray Fish-Liver Oils

	Oil # 1	Oil # 2
Vitamin A estimate at 325 μ (unsaponifiable)...	8,330	8,271
Ratio E $\frac{1\%}{1\text{cm}}\frac{260}{325}$ "	0.236	0.330
" " $\frac{280}{325}$ "	0.347	0.446
" " $\frac{300}{325}$ "	0.656	0.728
" " $\frac{350}{325}$ "	0.466	0.478
Vitamin A estimate at 328 μ (whole oil).....	8,160	9,000
Ratio E $\frac{1\%}{1\text{cm.}}\frac{260}{328}$ "	0.326	0.738
" " $\frac{280}{328}$ "	0.420	0.807
" " $\frac{300}{328}$ "	0.690	0.883
" " $\frac{350}{328}$ "	0.574	0.565
Peroxide value.....	0	16.7
Free fatty acid.....	0.23	0.67

Each of the oils was diluted with refined sunflower seed oil (peroxide value, 2.75; f.f.a., 0.3 per cent) and with water to potencies of both 50 and 150 units/cc., based on the vitamin estimate on the unsaponifiable fraction. The water emulsions were prepared by using 1 per cent "methocel" (400 centipoise) as the emulsifying agent. The oils and water for the preparations were deaerated, saturated with nitrogen, and stabilized with 0.05 per cent mixed tocopherols and 0.1 per cent soybean lecithin. In addition, the water phase of the emulsions was stabilized with 0.05 per cent gallic acid. Oils and water emulsions were stored in a cool place until ready for use. The emulsions were thoroughly shaken before use to ensure uniformity.

To determine the efficacy of the vitamin A in the carriers a biological assay was carried out with chicks, using essentially the technique described by Biely and Chalmers (*1*). Nine groups of 15 New Hampshire pullet chicks were standardized by weight at 7 days and then fed the vitamin A solutions by pipette (per os) every other day. Four of these groups were fed at the rate of 25 units/day, four others received 75 units/day and the remaining one was kept as a negative control (Table 2). The chicks which were fed the water emulsions of vitamin A were given 1 cc. of sunflower seed oil, one day after vitamin A feeding, to equalize the fat intake in the different groups. The chicks were weighed once a week for 7 weeks, and a record of mortality and autopsy findings was kept. Table 2 shows the results of the experiment.

It will be seen from Table 2 that all groups of chicks receiving the vitamin A in the form of a water emulsion grew at a markedly greater rate than those fed vitamin A in oil. Since the basal diet appeared to supply all the necessary nutrients (including the vitamins) in adequate amounts with the exception of vitamin A, it would appear that the critical factor

TABLE 2

Weight of Chicks Fed Vitamin A in Different Carriers

Group	Units/cc.*	Description	Days					Total gain
			7	30	37	44	51	
			(Grams)					
1	50	Vitamin Oil # 1 in vegetable oil	67.3	279.8	326.0	383.9	400.1	
2	50	Vitamin Oil # 2 in vegetable oil	68.3	278.0	289.6	327.1	349.5	
3	50	Vitamin Oil # 1 in water emulsion	66.1	306.6	378.4	448.9	467.6	
4	50	Vitamin Oil # 2 in water emulsion	67.3	295.8	325.9	400.3	416.9	
5	150	Vitamin Oil # 1 in vegetable oil	67.3	312.7	408.6	507.4	549.3	
6	150	Vitamin Oil # 2 in vegetable oil	66.4	303.3	377.0	461.6	495.9	
7	150	Vitamin Oil # 1 in water emulsion	67.0	347.1	451.0	578.5	616.1	
8	150	Vitamin Oil # 2 in water emulsion	65.0	329.3	407.5	534.6	575.4	
9	0	Control (no vitamin A)	67.0	All dead	—	—	—	

* Fed 1 cc. every second day in all cases.

in these studies was the kind of carrier in which the vitamin was supplied. Experimental data obtained in this laboratory (*4*) show also that a watery emulsion of vitamin A, when mixed in feed, produced slightly better growth in chicks over a period of 7 weeks than a feeding oil which had herring oil as a carrier.

Examination of the data also shows that fresh gray fish-liver oil, whether fed in oil or as water emulsion, resulted in somewhat greater growth than oxidized gray fish-liver oil.

The above experiment is being repeated on a larger scale in order to obtain sufficient data to determine statistically the extent of the differences between the two vitamin A carriers. The preliminary findings reported here show that the use of water emulsions of vitamin A can be of theoretical and practical importance in the biological assay of vi

min A with either rats or chicks, and in the field of nutrition—especially in those cases where fat metabolism is disturbed.

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Natural Formation of Petroleum-like Hydrocarbons From "Oil Shales"

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In many localities throughout the area of the exposed lacustrine Green River facies of the continental Eocene of Colorado, Utah, and Wyoming are exposures of porous and permeable rocks containing a viscous liquid hydrocarbon. This material, soluble in CS_2, CCl_4, ether, and petroleum solvents, has apparently been produced naturally from the enveloping "oil shales."

The best of these porous and permeable beds are several thin, 2 inch to 14 inch layers of volcanic ash (*1*), now largely altered to crystalline analcite and chalcedonic silica. Several of these layers are regionally persistent, but locally there are present from 15 to 36 additional such ash layers ranging from 1/32 inch to 20 inches in thickness. These are intercalated with the organic marlstones or "oil shales" of the Green River beds. Some of these beds, ranging in porosity from 15 to 20 per cent and having a permeability of from 7 to about 30 millidarcys, are enveloped by beds of rich organic marlstone. Standard porosity and permeability tests made on samples of this rich marlstone give results approaching zero, but there is enough permeability along the bedding planes of the material in place for sodium carbonate efflorescence to form on a fresh surface in a month's time.

In areas where there has been no appreciable tectonic activity, these beds of altered volcanic ash are commonly free from all traces of either (1) petroleum-like liquid hydrocarbons soluble in the usual solvents or (2) pyrobituminous material such as is contained in the "oil shales."

However, in local areas of rather moderate folding, such as is encountered near the Grand Hogback in Colorado or along Evacuation Creek in Utah, and in some areas of more gentle dips, some of the less stable, yellowish, amorphous kerogen of the "oil shales" adjacent to these porous analcitic layers has been transformed to a dark brown, waxy, semifluid hydrocarbon. This material fills the pore spaces of the analcitic beds and also the joint cracks of the enveloping "oil shales."

This hydrocarbon is identical with the heavier cuts of shale oils produced from the Green River "oil shales" by usual retorting methods. This may be an intermediate step in the production of gilsonite by inspissation of such hydrocarbons produced by natural (geothermal?) cracking of the pyrobitumens present in the organic marlstone of the Green River lake beds. A substance identical to gilsonite can be produced in the laboratory from "oils" of the type described above.

The above occurrences are offered as field evidence of the existence of such natural "cracking" of pyrobitumens into a liquid hydrocarbon superficially resembling some types of petroleum.

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Plasma Accelerator Factor and Purified Prothrombin Activation[1]

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Recently attention was focused on the presence of a substance in plasma which accelerates the activation of prothrombin (*1*, *6*). Partial purification of this factor has made available a product useful for the study of prothrombin activation (*6*). The newly-recognized factor is a plasma globulin which we refer to as Ac-globulin.

We mentioned in 1938 that partially purified prothrombin is slowly converted to thrombin in the presence of optimum amounts of calcium and thromboplastin (*4*). Such slow activation is illustrated by curve A of Fig. 1. When a small amount of

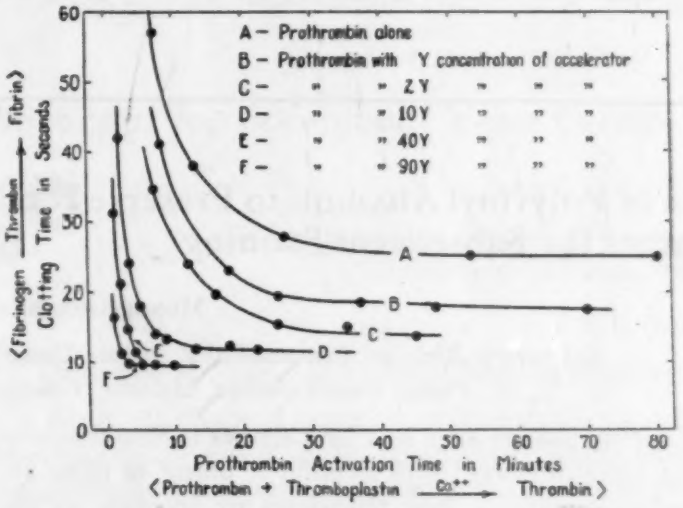

Fig. 1. Activation of purified prothrombin with optimum amount of thromboplastin and calcium. Only Ac-globulin concentration was varied.

Ac-globulin (Y concentration) is first added to the prothrombin, the activation rate of the latter is increased, as shown by curve B. With 2Y, 10Y, and 40Y concentration of Ac-globulin the activation rate is further increased, as illustrated by curves C, D, and E, respectively. Finally, with 90Y concentration of accelerator the activation rate is virtually equal to that of native plasma prothrombin itself (curve F). Heretofore it seemed likely that slow activation of purified prothrombin was the result of damage done to the fragile molecule during the purification procedures. This work shows, however, that it is necessary only to supply Ac-globulin in order to activate

[1] Aided by a grant from the National Institute of Health.

purified prothrombin in the same manner as prothrombin not handled by various laboratory manipulations.

The curves of Fig. 1 also show that the *quantity* of thrombin obtained from purified prothrombin is increased by addition of the plasma factor. As the Ac-globulin concentration is increased, the following changes occur: first, both the rate of activation of the prothrombin and the thrombin yield increase; next, the activation rate shows the predominant increase, but thrombin yield still improves; finally, only activation rate increases, but there is no longer a significant increase in thrombin yield. This sequence of events is the pattern obtained when changes in pH, calcium concentration, NaCl concentration, and other variables are made to interfere with the optimum interaction of prothrombin and thromboplastin (*2*). Whenever activation rate is appreciably reduced, the eventual yield of thrombin is also reduced. Presumably this is due to the fact that side reactions have time to produce their effect. It has been shown, for example, that partial activation of purified prothrombin yields a substance, very likely thrombin, capable of destroying prothrombin (*3*).

Through experimental approaches of this kind it has been possible to obtain a preliminary quantitative conception of Ac-globulin concentration and its function. Normal plasma contains the factor in generous quantity. We must, however, simultaneously consider prothrombin concentration. The current viewpoint is that a bleeding tendency develops when this drops below 10 per cent of normal. It is now apparent that this tendency can be accentuated by a low Ac-globulin concentration. On the other hand, a high concentration of Ac-globulin can compensate for a low prothrombin concentration by forcing rapid production of thrombin and, therefore, quick clotting of blood.

The prothrombin used in this work was prepared by $(NH_4)_2SO_4$ fractionation, as described previously (*5*). It possessed a maximum specific activity of 23,000 units/mg. tyrosine. The Ac-globulin was also purified by methods previously described (*6*). Prothrombin activity was measured by the two-stage method.

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IN THE LABORATORY

Use of Polyvinyl Alcohol[1] to Preserve Fecal Smears for Subsequent Staining

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Fecal samples are often sent for diagnosis to distant laboratories, either preserved with formalin or phenol or in an unpreserved condition. These procedures are adequate for the subsequent identification of any protozoan cysts and helminth forms present, but protozoan trophozoites are almost always destroyed or rendered unrecognizable.

This note describes a method which makes it possible to submit trophozoite material in fixed smears on slides, to be stained and examined when received at the diagnostic laboratory. A fixative is embodied in water-soluble polyvinyl alcohol, which then serves the dual purpose of fixing the fecal smear and forming a temporary mount during shipment.

The mounting medium is prepared by dissolving, in a water bath, 20 grams of powdered Elvanol in the following solution: saturated aqueous solution of mercuric chloride, 130 cc.; 95 per cent alcohol, 60 cc.; glacial acetic acid, 50 cc.; and phenol, 50 cc.

Preparation of smear for shipment. A thin fecal smear is prepared on a clean slide in the usual manner. The smear should not be permitted to dry. It is then covered with a generous amount of the Elvanol solution, using a medicine dropper, and a cover slip applied as in ordinary mounting. In from 2 to 4 hours, depending upon the quantity of solution used and the room temperature, the slide will be dry enough for mailing in any container in which the smears will not be subject to pressure.

Removal of mounting medium prior to staining. The slide is soaked in a 5 per cent aqueous solution of glacial acetic acid at 60°–70° C. until all of the Elvanol film has been dissolved from the smear and the cover slip drops off. This usually takes about 15 minutes. The slide is then rinsed in tap water for 3 minutes and stained in the usual manner with iron-alum hematoxylin. Most organisms will stain as they do following ordinary fixation, except for a tendency to require longer destaining in the differentiating solution.

Preliminary experiments show that protozoan cysts and trophozoites as well as helminth eggs are well preserved by this method. Fecal smears prepared in this manner may be submitted to the laboratory with a reasonable assurance that the intestinal parasites present will be recognizable following staining with iron-alum hematoxylin.

[1] The product used by us is specified as "Elvanol 90-25" (formerly "polyvinyl alcohol, Grade RH-349-A, Type B, medium viscosity"), obtainable from the E. I. du Pont de Nemours & Company, Electrochemicals Department, Niagara Falls, New York.

Elimination of the False Positive Reaction With Human Sera in Complement Fixation Tests[1]

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In a recent paper DeBoer and Cox (*5*) reported that complement fixation tests for the diagnosis of eastern and western equine encephalomyelitis employing infected chick embryo antigens as described by the author (*1*) or the mouse brain antigens of Casals (*4*) were not truly specific in that these tissues fixed complement with known positive human syphilitic sera. This phenomenon had been described previously by Wertman, who used normal yolk sacs or chick embryos (*7*). DeBoer and Cox described a procedure for extraction of the antigens in the lyophilized state with benzene, toluene, or dichlorethylene, which eliminated the so-called false positive reactions. Twenty-two individual and 14 pools of syphilitic sera were tested. The authors failed to mention the temperature of inactivation for these human sera, merely referring to the method of Kolmer and Boerner (*6*) for the technique of the complement fixation test in which 55° C. for 20–30 minutes is recommended.

TABLE 1

EFFECT OF INACTIVATION TEMPERATURE ON COMPLEMENT FIXATION TESTS

Serum	No.	Titer with irradiated chick embryo antigens								
		56°C.—30 min.	60°C.—15 min.							
			0	1/4	1/8	1/16	1/32	1/64	1/128	1/256
Pos. syphilitic	6	1/64	5	1						
" "	14	1/128	9	4		1				
" "	8	1/256	3	2	2	1				
Neg. "	3	1/16	2	1						
" "	2	1/32	2							
" "	1	1/128					1			
WEE immune	4	1/256							4	
EEE immune	1	1/64				1				
"	2	1/128						1	1	
"	1	1/256						1		

Casals (*2*, *3*, *4*), using infected mouse brain antigens, has repeatedly stressed the importance of different temperatures of inactivation according to the species of serum under test and recommends 60° C. for 20 minutes with human sera. In this laboratory, complement fixation tests employing irradiated antigens derived from infected chick embryos have proved satisfactory in the detection of antibodies for eastern and western equine encephalomyelitis viruses provided the sera are properly inactivated. Although temperatures of 55° or 56° C. are acceptable for some animal sera, they are definitely unsatisfactory for human sera. In a series of tests with 34 human sera obtained from the syphilis clinic, false positive reactions were obtained in titers ranging from 1/16 to 1/256 when the sera had been inactivated at 56° C. for 30 minutes. When these same sera were treated at 60° C. for 15 minutes, 21, or 61 per cent, were completely negative, and the titers of the remainder were reduced from 16- to 64-fold. On the other hand, sera containing antibodies for eastern or western equine encephalomyelitis viruses either retained their original titers or dropped only 2-fold or 4-fold after being inactivated at 60° C. Table 1 presents these results. Obviously, the vast difference in the capacity of specific sera to resist this higher temperature of inactivation provides a qualitative diagnostic criterion. This remarkable difference of only 4° C. is best illustrated by the following example: A pool of positive syphilitic human sera heated at 56° C. gave a false positive reaction with the chick embryo antigen to a titer of 1/64 after as long as 120 minutes at that temperature. When this identical pool was subjected to a temperature of 60° C., the titer was reduced to 1/16 after 5 minutes, 1/8 at 10 minutes, and was completely negative after 15 minutes inactivation.

The simple expedient of inactivating human sera at 60° C. for 15 minutes instead of 56° C. for 30 minutes, when used for complement fixation tests with antigens derived from chick embryos, makes unnecessary the elaborate techniques suggested by DeBoer and Cox for purifying virus antigens.

[1] Aided by a grant from the National Foundation for Infantile Paralysis, Inc.

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Apparatus for Continuous Yeast Culture

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A simple batch type of continuous culture apparatus which provides a daily series of freshly grown yeast cultures for experimental use was developed and used during studies on yeast metabolism (*7*, *9*). This apparatus is useful in reducing to a minimum daily, time-consuming culture manipulations. A rubber stopper-glass tubing joint permits the rapid and aseptic withdrawal of part of all of the culture and assures its continuation by immediate renewal and automatic reinoculation of the medium.

The apparatus is inexpensive and easily constructed, from glassware and supplies available in most laboratories, to suit various capacity requirements. It is easily dismounted, cleaned, resterilized, and returned to operation, and is adaptable to various types and shapes of culture vessels.

The apparatus should prove useful in the continuous serial batch cultivation of any aerobic organism capable of multiplying when suspended in a liquid medium. Agitation of the suspension sufficient to distribute nutrients and oxygen and remove metabolic end-products is considered important to high

crop yield (*1, 8*). While air-flow agitation alone does not always establish optimum aeration conditions in this type of culture, addition of vigorous mechanical agitation tends to do so (*1, 3*). Pure oxygen flow alone, however, would result in conditions more nearly equivalent to those existing at the surface of an agar plate (*7, 8*). The apparatus described here fulfills such

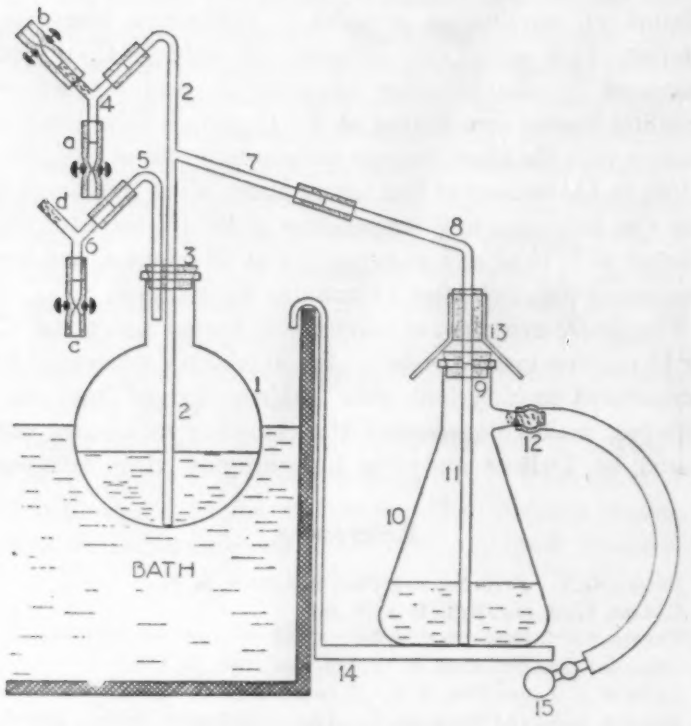

FIG. 1

requirements at an intermediate aeration level in a simple form. It avoids the disadvantage in methods of the type described by Moor (*6*) and Klem (*4*), in which cells are permitted to sediment in a thick layer, and it is simpler and less expensive for small-scale cultures than the mechanically agitated apparatus described by Feustel and Humfeld (*3*). Other simple culture vessels which provide extensive aeration agitation are described by Magoon and Brunstetter (*5*) and Stier and Stannard (*10*).

Fig. 1 shows a diagram of the apparatus set up with an ordinary boiling flask as the culture vessel. The parts required for one unit are one culture vessel, glass Y- or T-connections, a glass powder funnel, a supply of filter flasks fitted with one-hole rubber stoppers, spring-type pinchcocks, glass tubing, and rubber stoppers and tubing of suitable type and size.

In preparing the apparatus the parts may conveniently be handled as three separate units. The openings of the vessels and the intravessel tubing are covered with heavy paper. Several filter flasks, 10, each containing a predetermined amount of medium and equipped with a rubber stopper, 9, glass tube, 11, and a cotton air filter in or attached to side tube 12, are covered with paper caps. The three units are then autoclaved.

A series of cultures is begun by assembling the units with ordinary aseptic precautions. The medium in one filter flask is inoculated. The paper cap is removed from the powder funnel, 13, and the free end of tube 8 is inserted *halfway* into the rubber stopper to contact tube 11. This is the rubber stopper-glass tubing joint mentioned above. The joint has proven stable with a tight friction fit and may be improved by cementing tube 11 into the stopper with a latex preparation.

Connection to a source of washed and moistened air or oxygen is made through side tube 12. Slight gas pressure forces the inoculated medium through the aeration-siphon tubes, 8, 7, 2, into the culture vessel. Exhaust gases are vented through tubes 5 and 6. Cotton air filters at 4b and 6d prevent airborne contamination of the culture during siphoning operations. Pinchcocks at 4a and 4b prevent loss of medium through the upper limb of tube 2 during transfer from flask 10 to the culture vessel. Moisture traps and drains are provided at 4a and 6c to prevent soaking of the cotton filters by moisture condensing in tubes 4 and 6.

Powder funnel 13 protects the joint in stopper 9 from airborne contamination. The funnel is held on tube 8 by a piece of rubber tubing which is fastened into the funnel by use of liquid latex. The funnel should slide on tube 8 to permit a snug fit on different rubber stoppers. The movement required is slight. The rubber tubing supporting the funnel is prevented from adhering to tube 8 by lubricating with glycerol or powdered graphite before autoclaving.

Samples or the whole culture may be withdrawn at will by using tubes 2, 7, and 8 as a siphon. The siphon is started by removing the gas-supply tube and applying slight suction at side tube 12 or slight gas pressure at 6d. Siphon action can be instantly stopped by opening pinchcock 4b, thus "breaking" the liquid column at the junction of tubes 2 and 7.

Reinoculation is accomplished by "breaking" the siphon before all of the culture is withdrawn. Amounts of inoculum varying in size from the few drops of liquid left on the walls of culture vessel and siphon tubes to any larger amount desired may be obtained. A very small amount of the initial inoculated medium or sterile renewal medium may fail to transfer from the filter flask to the culture vessel. This amount is usually negligible. However, substitution of a dry, sterile filter flask unit after transfer of the medium prevents any difficulty at this point. After withdrawing samples of culture and before attaching a flask of fresh medium, the end of tube 8 is flamed.

Rubber parts made of neoprene give better service than natural rubber. Plastic tubing such as Tygon (S22-1), which is somewhat transparent, should be an improvement over rubber. The apparatus is sufficiently rigid so that only the culture vessel and filter flask need support. The joint between tubes 7 and 8 was included to give the aeration siphon flexibility when changing filter flasks. A gas manifold, 15, attached under the shelf as shown is convenient for operating parallel cultures.

A reservoir for sterile culture medium attached to the aeration siphon may be substituted for the supply of medium-containing filter flasks (*2*).

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Book Reviews

An introduction to mathematical genetics Lancelot Hogben. New York: W. W. Norton, 1946. Pp. xii + 260. (Illustrated.) $5.00.

It has been said that no branch of knowledge has become a science until it has been placed on a quantitative basis. However much we may question this view in its application to the general field of biology, we can entertain no doubts of its truth in the special case of genetics. Experiments in hybridization were common enough before Mendel, but they were gropings in the dark, counting for little because they aimed at something beyond attainment by any of the methods used. Mendel changed all that and founded the science of genetics, by showing the way to give hybridization experiments direction and meaning. Biologically, his fundamental innovation was the concept of the particular determiner or factor, in terms of which inheritance was capable of simple description. But this idea would have been of little avail without the means of translating the biological properties of the factor into the numerical properties of the population. Only by these quantitative means could he test his theory and his successors elaborate it.

Mendel's mathematics were simple, both in his derivation of the ratios to be expected from the theory, for which purpose he used the binomial expansion, and in his statistical reduction of the experimental data for testing their agreement with these expectations. Indeed, his statistical treatment consisted of little more than the calculation of the ratios from his data and the recognition that sampling error would lead to these observed ratios only approximating those expected. Later, with very little elaboration these simple methods satisfied all the needs of the early geneticists. Indeed, the algebra of the binomial theorem was often replaced by the simpler, if more tedious, geometry of the checkerboard.

If mathematical genetics had rested at this stage, there would have been found little about which to write; but, as time went on, elaboration became necessary. New statistical methods were needed for the adequate testing of ratios and for the calculation of linkage values from F_2's. Also, the simple methods were no longer enough when geneticists turned their attention to the wider fields of inbreeding, assortative mating, equilibria and change under mutation and selection, and the measurement of gene frequencies in naturally-breeding populations such as man. The ensuing mathematical developments are especially associated with the names of Fisher, Haldane, and Wright; but many others have contributed, and the literature is both extensive and scattered. Prof. Hogben, in a book which is based on a course given to postgraduate students of the University of Wisconsin, has brought many of these results together and attempted to make their derivation intelligible even to those geneticists whose mathematical background is limited.

The book falls into three parts. In the first the author lays the foundation, both genetical and mathematical, for his later treatment. He considers certain basic genetical conceptions, such as those of gene frequencies and mating systems, and illustrates them and their applications by reference to models made with playing cards. The mathematical introduction is more elaborate and includes accounts of certain algebraic series and their manipulation, the calculus of finite differences as used in handling these series, and the binomial expansion, both complete and incomplete.

These foundations having been laid, attention is turned in the second part to the effects of selection, assortative mating and inbreeding, mutation, and isolation. This section is prefaced by some remarks on what the author calls the limitations of mathematical genetics. They are concerned with the principles of gene expression and their effects on the validity of the mathematical findings. The treatment is most comprehensive in regard to the types of selection and systems of mating covered, but their consequences are considered only as they apply to single genes. Systems of genes are not dealt with. As we might expect from the author's own interests, the special problems of human genetics are well to the fore in both treatment and example.

The third part consists of two appendices, one on tests of significance and the other on statistical estimation. These topics are dealt with in a more mathematically thorough than a practically comprehensive way. The most valuable method of testing significance in genetics is by the use of X^2. Yet this is not granted any mention. Again, the method of maximum likelihood is presented without any account of its value in dealing with fragmentary and combined data. It is impossible, of course, to deal adequately in 43 pages with the statistical methods used in genetics, whether from the mathematical or the analytical point of view. Such a brief account should be omitted if space forbids a more comprehensive survey.

The space gained by an omission of the appendices might well have been devoted to developing further the mathematical treatment of genetical situations, which forms the main theme of the book. As we have seen, the topics taken up are discussed thoroughly, but their range is limited. Neither Fisher's treatment of the theory of selection nor Wright's of the composition of populations is included. Admittedly, both are necessarily complex but cannot be neglected on that account.

Formal genetics, the study of hereditary transmission, has shown us how the genotype is built up of the units we call genes, and how these units can change and recombine to give variation of the genetic structure. We are now seeking to enlarge on this foundation, on the one side to understand how the genes themselves are built up and how they act in development, and on the other to understand the genetical composition of populations in all their variation, both natural and under domestication. When we consider, for example, the problems posed by heterosis and its efficient use in agriculture, it is clear that there is still much ground to cover. Our knowledge is as yet almost entirely empirical. To achieve genetical understanding we must work out the properties not only of single genes, but of systems of genes—genes which are not separable in analysis, but which can reinforce and balance one another in variation. Prof. Hogben, like Mendelian genetics

itself, takes us only part way, because, as we saw, he deals with genes only one at a time. He shows us how to cope with the problem of red and white cows in our herds of black and white Friesians. He does not tell us how to cope with the problems of their milk production.

The student will find that this book well repays study. There are a few misstatements of genetical fact, as when it is said that in *Primula* species individuals homozygous for the thrum gene are nonviable, and a few of mathematical scope, as when it is stated that the recombination value can be estimated from F_2 data only when it is the same in both sexes. Nevertheless, this book is unique in the genetical ground it covers and in the attempt to explain the mathematical methods used. Having mastered it, the student will have a deeper insight into the formal properties of mating systems and the formal workings of selection, the principles of which, as Prof. Hogben suggests, are basic to the application of genetics in agriculture and human affairs. Before he can cope with the problem of applied genetics, however, the student will have to learn how these principles are used in a wider variety of situations, in some of which genetical complexity at present precludes mathematical rigor.

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The birds of North and Middle America. (Pt. X.) Herbert Friedmann (commenced by the late Robert Ridgway). (U. S. National Museum Bull. 50.) Washington, D. C.: Government Printing Office, 1946. Pp. xii + 484. (Illustrated.) $1.25.

The present volume, Part X of a monumental catalog of birds of North and Middle America, is concerned with the order *Galliformes*, including the families *Cracidae, Tetraonidae, Phasianidae, Numididae,* and *Meleagrididae.* The scope of Ridgway's and Friedmann's work is indicated by its subtitle: *A descriptive catalog of the higher groups, genera, species and subspecies of birds known to occur in North America, from the Arctic lands to the Isthmus of Panama, the West Indies and other islands of the Caribbean Sea, and the Galápagos Archipelago.*

Volumes in this series deal with description, range, and synonymy, but not with life history. The series, therefore, serves to complement A. C. Bent's *Life histories of North American birds,* also published by the U. S. National Museum. Bent, however, deals only with the birds of the United States and Canada, whereas the present series is concerned with the birds of the entire North American continent and adjacent islands. This more comprehensive treatment is invaluable to the systematic ornithologist who is concerned with continent-wide distribution of races, species, and genera.

As with many other bird orders, the problem of races in the *Galliformes* is a difficult one, and the author must exercise his own choice and judgment in the treatment which he accords them. For example, the present volume, quite naturally, follows the revision of Aldrich and Friedmann in treating the ruffed grouse (*Bonasa umbellus*). There are other systematists who do not agree with this revision. Further, although the racial treatment of the Bob-white (*Colinus virginianus*) has recently been extensively revised by Aldrich, the present volume does not follow his revisions.

In order of appearance, this series of bulletins has virtually reversed the presently-accepted A.O.U. Check-list arrangement. Part I catalogs the *Fringillidae,* and later parts treat other groups in reverse order. Two additional parts now in preparation, or awaiting publication, and dealing with the orders from *Falconiformes* to *Gaviiformes* will complete the catalog.

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Scientific Book Register

ASSOCIATION OF VITAMIN CHEMISTS, INC. (Eds.) ***Methods of vitamin assay.*** New York-London: Interscience, 1947. Pp. xviii + 189. $3.50.

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